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PMM

Precision Metal Molding

INCLUDING DIE CASTINGS MAGAZINE

JUNE
1956

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"The die caster worked with us from the earliest stages of design . . ."

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See Page 3

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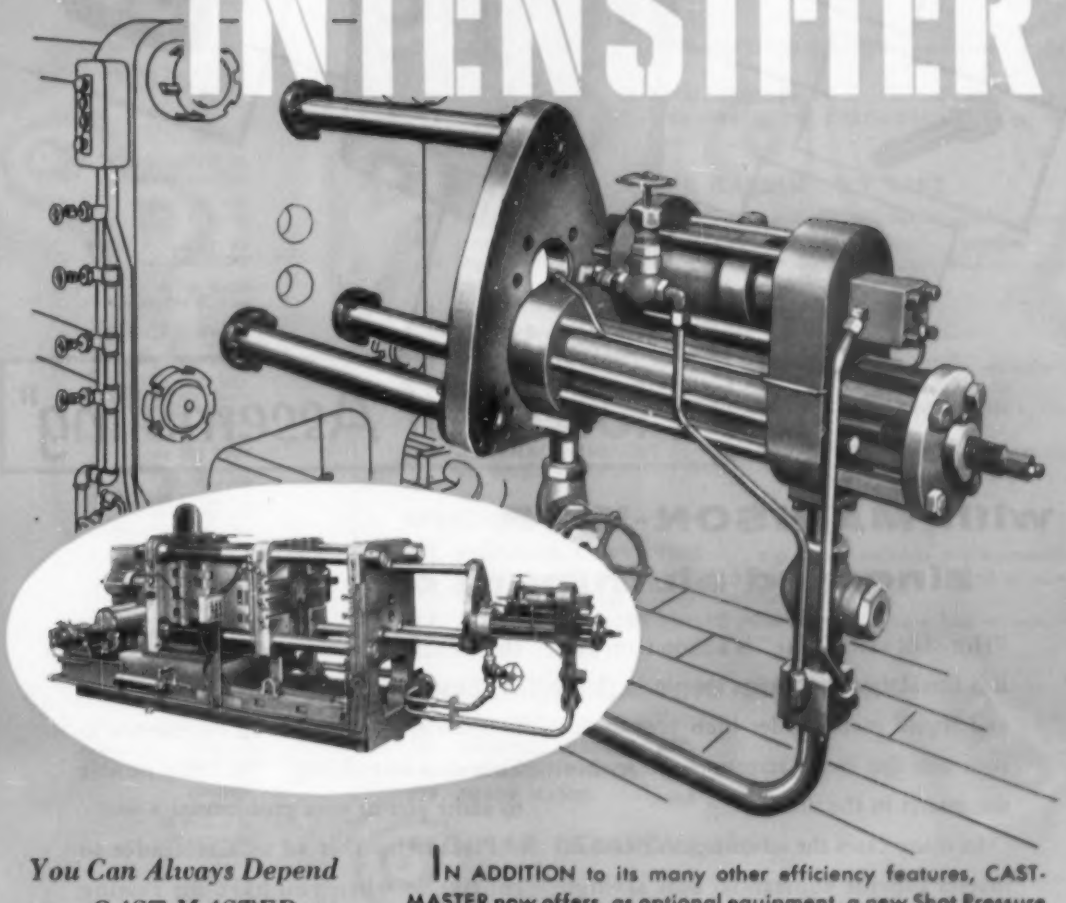

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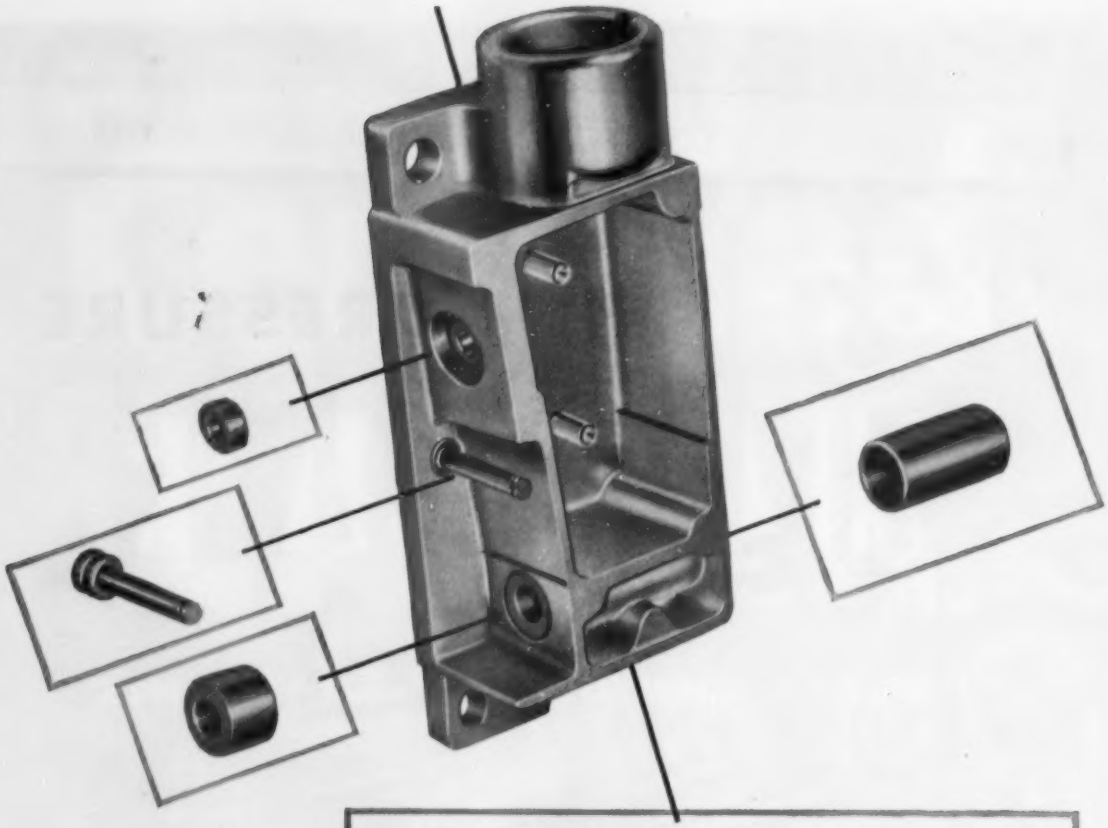

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COVER STORY

BOTH aluminum and zinc die castings contribute to the performance and economy of this multi-function garden tool & household appliance. For details, see Page 52.

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JUNE, 1956 VOLUME 14 NUMBER 6

Precision Metal Molding

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these 3 fine steels

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cover the entire range of your light metal die and plastic mold requirements

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The 6 grades of Die Slick

Here is brief information on the six different grades of Die Slick—more detailed information will be sent on request.

No. 3—Aids parting and ejection on difficult ALUMINUM and MAGNESIUM castings. Non-staining. Enables better metal flow and fill-out of castings.

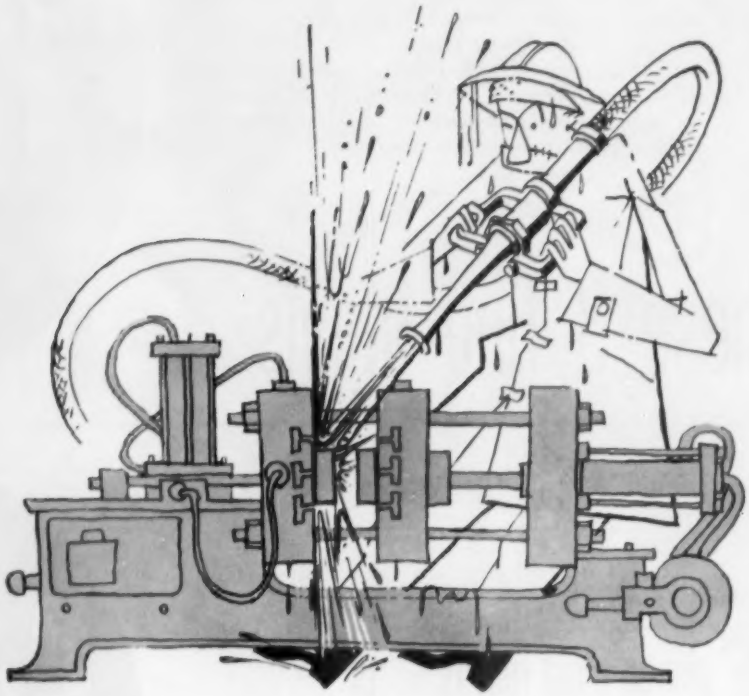
No. 4—Expressly for BRASS castings —sometimes used on aluminum and magnesium. Extra heavy-duty compound with lubricating graphite. Retains lubricity under high heat.

No. 9—For clean "hardware" finish ZINC castings, where finest plating results are required. Assures maintenance of clean cavities, cores, ejector pins, and guide pins.

No. 11—General purpose compound for ZINC castings. Generally stain-free unless applied too heavily. Prevents sticking and scoring.

SG—Standard grade compound for general use on ALL alloys except brass. A high viscosity amber fluid that is not readily burned off by the heat of the dies.

PS—Plunger-Slick is an adherent viscous compound that will not melt under highest casting temperatures. Expressly for cold chamber machines, it prevents scoring, sticking, or wear on plunger parts. No. 21—(silver) for average use on all alloys. No. 34—(black) has added micronized graphite for extra high lubricity.



Don't use TOO MUCH Die Slick!

One big advantage of Die Slick is that a little goes a long way. Die Casters have found that the easy, reliable way to prevent sticking, poor surface finish, and ejector pin wear is really the least expensive way. Any of the six grades of Die Slick can be reduced to the desired consistency, then sprayed on with a blow-pipe. On new dies, lubricate after each shot until the die is worked in, then at less frequent intervals depending on alloy and die complexity. Try a week's supply of Die Slick in your plant at our risk—if you don't like it, we'll cancel the invoice. Simply specify the metal or alloy you are casting.

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CASTING ABOUT

technical news of applications & processes involving precision metal moldings

Coming next: The die cast V-8?

. . . with cast liners?

WATCH THESE AUTOMOTIVE DEVELOPMENTS . . .

DIE CAST 8-CYLINDER ENGINE BLOCKS are on the way! Having successfully die cast an experimental 6-cylinder automotive engine block in aluminum (PMM, Jan. '56, pg. 36) the Doehler-Jarvis Division of National Lead Company has started design work on a V-8 block to be die cast in one piece. According to Alfred F. Bauer, chief engineer and assistant general manager of the division, "Much progress has been made on the design of a V-8 engine block and several designs have been completed. The main problem of conversion is the same as with the 6-cylinder block . . . the V-8 block has to be completely redesigned following a three-point program . . . no undercuts, no heavy walls, and all holes cast in." The V-8 block is expected to weigh between 50 and 70 pounds and bring about a 10 percent reduction in cost.

WET-LINER ENGINE DESIGNS using centrifugally cast liners promises to be especially suitable with die cast aluminum engine blocks . . . but also offers great economy and functional advantages when used with cast iron blocks. The design calls for separately cast liners assembled into the cast block, with coolant circulation around the cylinders. Ralph Teetor, president, and Arthur M. Brenneke, chief engineer, of Perfect Circle Corp., have listed some of the advantages of this type of design: 1) Larger cylinder bores are possible; 2) Less coolant is required; 3) Faster warm-up is possible; 4) Replacement is simple; 5) Cylinder material has better hardness, good machinability; 6) Cylinder walls are uniform in thickness; 7) There is less danger of cylinder distortion; and 8) Better head gasket performance is achieved.

Perfect Circle has developed a technique for casting the liners centrifugally and has now published a brochure describing the features of wet-liner construction. Selling price for finished cylinder assemblies is expected to range between $11 and $15 per 8-cylinder engine. By contrast, one typical V-8 block, rough casting weighing about 200 pounds, costs its manufacturer $38 (including burden) as it leaves the foundry.

GAS TURBINE ENGINE GETS A CROSS-COUNTRY RUN: Chrysler Corporation's experimental gas turbine-powered passenger car recently completed a 3,020 mile endurance run from New York City to Los Angeles. The turbine car, a 4-door Plymouth sedan, standard in every respect except power plant, averaged between 13 and 14 miles to the gallon cruising at 40 to 45 mph, and had only two interruptions for minor repairs during the trip. Looking over a gas turbine engine installed in a 1956 Plymouth are James C. Zeder, vice president-engineering, and George J. Huebner, Jr., executive engineer in charge of research. Mr. Huebner, shown holding a power turbine wheel, says that Chrysler engineers have solved two major problems . . . high temperature exhaust heat and high fuel consumption . . . but still have many metallurgical and manufacturing problems to work out before the gas turbine can be built in volume for production passenger cars.

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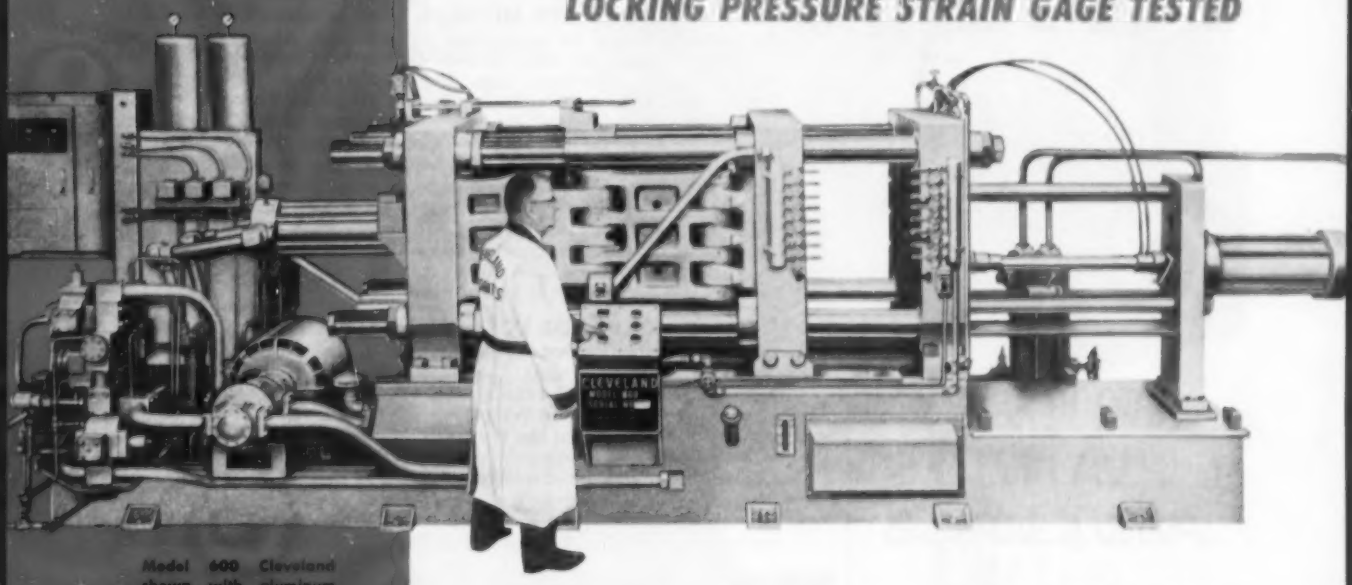
MODEL 600

GREATEST CLEVELAND YET!

New 600-Ton Universal Hydraulic Die Casting Machine

LOCKING PRESSURE STRAIN GAGE TESTED



Model 600 Cleveland shown with aluminum shot end. Also available as a hot chamber machine. Has 46½" x 46" die plates; 28" x 28" space between tie bars; 30" max.—10" min. die thickness; 8" - 15" die opening.

You're looking at the finest 600-ton die casting machine available today! The new Model 600 Cleveland was designed in every detail to give the die casting industry a machine of exceptional performance capabilities . . . high speed, reliable operation . . . safe and simple control . . . minimum maintenance. The developed machine more than met these specifications.

This new Cleveland will deliver castings weighing up to 10 lbs. aluminum, 25 lbs. zinc. An idea of the brawn built into the design—to back up its guaranteed 600-ton locking pressure—is indicated by the 38,000 lbs. net weight of the cold chamber machine shown above. Massive toggle system, 5" dia. tie bars and cross head guide bars, 7¾" thick platens, insure rigidity and accurate die alignment.

The hydraulic system is practically as leak-proof as can be built. Manifold valving is incorporated. Total pump capacity is 99 gpm. A 200 gal. oil reservoir is provided. Filter capacity is twice pump capacity. Two accumulators provide high injection speed.

Dozens of other highly important features—many are exclusively Cleveland's—are incorporated. You'll want to call in a Cleveland sales engineer for full details. In the meantime, factual information, well illustrated, in Bulletin 600 will give you plenty of incentive to reserve floor space for this new Cleveland in your shop. Write now for your copy.

Write for Bulletin 600

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And plating with Sel-Rex BRIGHT GOLD or RHODIUM or SILVER are the most economical of all processes . . . for Sel-Rex goes further, requires no buffing, burnishing or polishing, operates at room temperature on standard equipment.

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City _____ Zone ____ State ____

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CASTING ABOUT

continued from page 8

COPPER PRICE . . . WILL IT DROP THIS YEAR? The price of domestic copper is unlikely to rise in 1956, and some decline can be anticipated later on this year, according to *Perspective*, issued monthly by the Investment Management Department of Calvin Bullock, mutual funds managers. Both domestic and foreign mine production were higher during the first two months of the year than for the same period last year, and at the same time, foreign consumption has declined. As a result, the publication forecasts that the industry will be in an easier position throughout 1956.

DIE CASTINGS IN GUIDED MISSILES. What is reported to be one of the largest contracts for magnesium and aluminum die castings for use in guided missiles has been received by Harvill Corp., West Coast die caster. The joint contract from Motorola Research Laboratories in Phoenix and Convair Division of General Dynamics Corp. in Pomona, Calif., calls for light metal die cast components to be used in the electronics section of the Navy Terrier guided missiles. First phase of the contract is expected to run through 1957. The supersonic, rocket-propelled Terrier missile is designed to intercept enemy planes and put them out of commission before they can achieve their mission. They have been installed already on the U.S.S. Boston, the Navy's first guided missile ship. Other castings Harvill produces for missiles go into the Nike by Douglas Aircraft, the Falcon by Hughes Aircraft and the Sparrow by Sperry Farragut Division of Sperry Rand.

NOW, GLASS MOLDS FOR LOST WAX CASTING. One of the earlier limitations of the Glascast process (See PMM, Nov. 1955, pg. 36) was the need for using a split mold. This process for producing precision metal castings, utilizes the high silica glass powder developed by Corning Glass Works, but was originally limited to shapes that could be made in cope and drag. Refinement of the process, just introduced, permit adaptation of the lost wax technique of conventional investment casting. Special features of the new mold material are said to be: low coefficient of expansion (.00000047 inch per inch per degree F between 0 and 587 F), resistance to thermal shock, smooth surfaces. Details of mold making have been well worked out, yielding a shell ⅛ to ¼" thick. A special top-loading firing and dewaxing furnace has been developed; the low thermal expansion of the mold material permits the inverted mold to be placed in the furnace at 1920 F, so that the sudden heat causes the wax to melt and drop from the mold into a container beneath the furnace without expanding or burning. The Glascast process is reported to cut number of rejects on jet turbine blading to less than 10 percent.

Continued on page 12

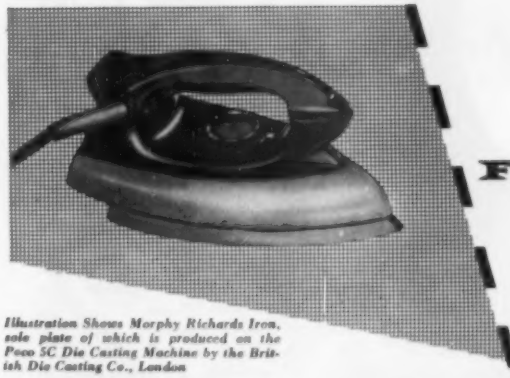


Illustration Shows Morphy Richards Iron, sole plate of which is produced on the Peco 5C Die Casting Machine by the British Die Casting Co., London

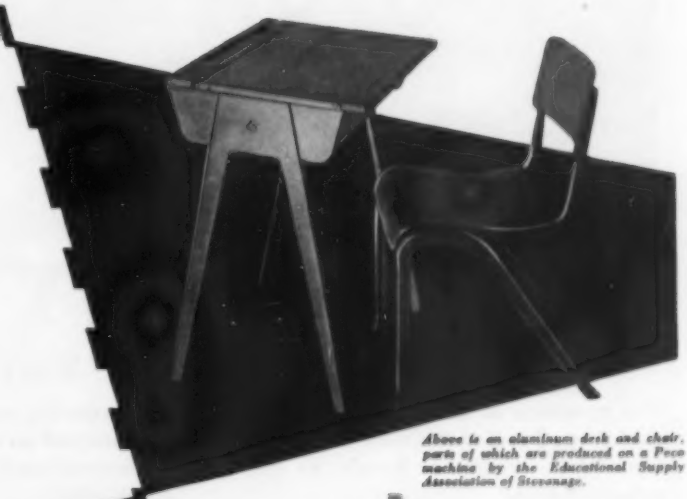
FROM ELECTRIC IRONS

TO SCHOOL DESKS

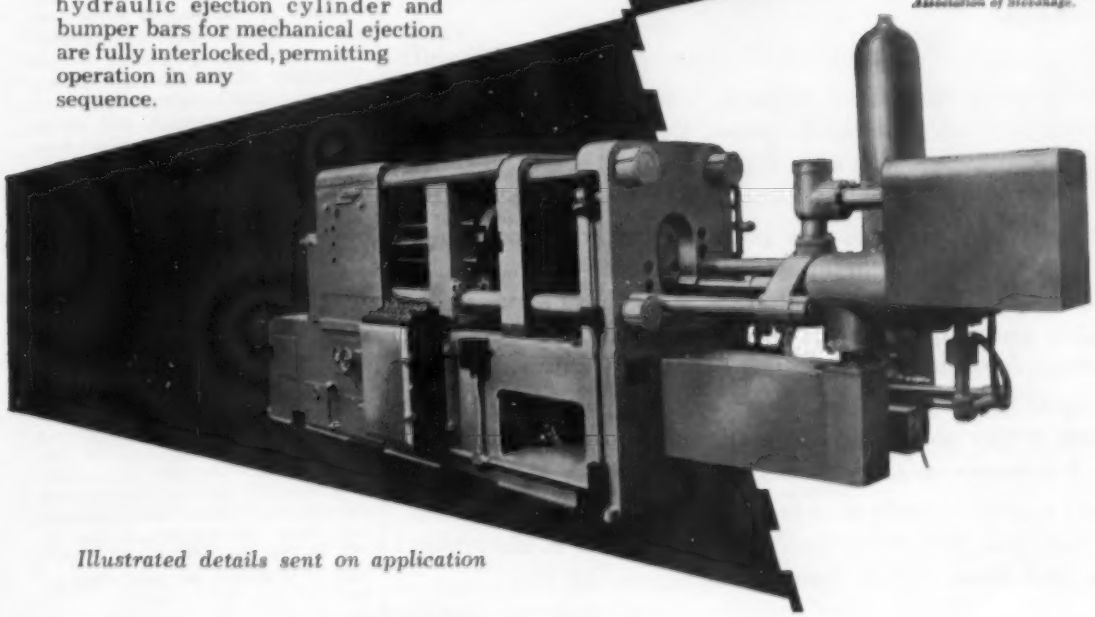
there's hardly any limit to the types of article being produced on

PECO DIE-CASTERS

PECO machines have completely modernized the technique of Cold Chamber Pressure Die-Casting and with the unique feature of electrical control, they are considerably in advance of other machines on the market. Four core-pulling connections, hydraulic ejection cylinder and bumper bars for mechanical ejection are fully interlocked, permitting operation in any sequence.



Above is an aluminium desk and chair, parts of which are produced on a Peco machine by the Educational Supply Association of Stevenage.



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PECO PRODUCTS

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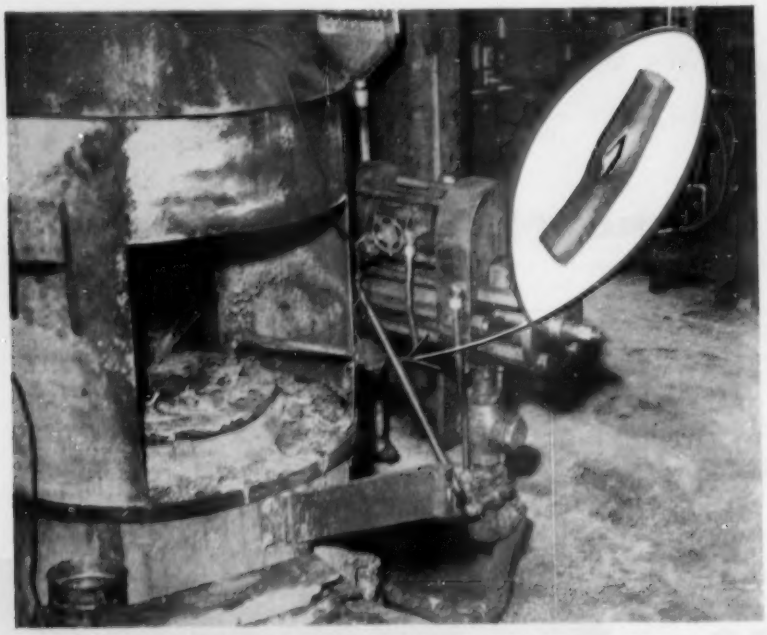

SUDDENLY--

this Hydraulic Line Burst

The operator of this die-casting machine screamed a warning and leaped out of the way as hydraulic fluid sprayed on molten aluminum from a break in the three-quarter-inch high-pressure line.

Then he turned off the control valve and went for a towel.

Nobody hurt, no million-dollar fire, no crippled plant . . . no drama here because the hydraulic fluid was Houghto-Safe —and Houghto-Safe won't burn. One man got pretty wet, and the burst hydraulic line had to be replaced, but that's all.

Houghto-Safe provides this positive fire-protection along with high hydraulic efficiency. Houghto-Safe is chemically stable, keeps its film strength throughout its long service life. Working parts always get protection from wear or from corrosion. And Houghto-Safe won't attack packings.

Houghto-Safe gains ready acceptance with personnel because it has no unpleasant odor and is completely non-toxic. It's harmless, and as fireproof as water.

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Ready to give you on-the-job service . . .

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CASTING ABOUT

continued from page 8

HI-FI IN YOUR AUTOMOBILE . . . WITH DIE CASTINGS! One extra problem in phonograph design is introduced with the designing and building of a hi-fi unit for operation in a moving automobile . . . how to overcome the bouncing, vibration, abrupt stops, road dust, atmosphere and other severe conditions. Yet CBS-Columbia has been able to do this in the high fidelity record player offered as optional equipment in Chrysler Corporation's line of cars. Part of CBS-Columbia's solution came from a job-shop die caster, who provides a rigid, stable base plate for the unit. Die cast in zinc alloy, the base plate illustrates the ability to place strength where it is needed, while eliminating needless weight and bulk in other sections. The complex zinc die casting weighs only 3.75 pounds before machining and painting. Proper support and assembly for maximum durability are "built-in" by means of cast projections and cored holes in the die cast base.

VACUUM METALLURGY FOR LOWER COST ALLOYS? Alloys suitable for use in automotive gas turbines at considerably lower cost are reported as the result of high vacuum metallurgy carried out at University of Michigan. A nickel-base alloy that has almost 40 percent higher tensile strength and up to 10 times the ductility of cobalt-base alloys, is reported by Richard Flinn, metallurgy professor.

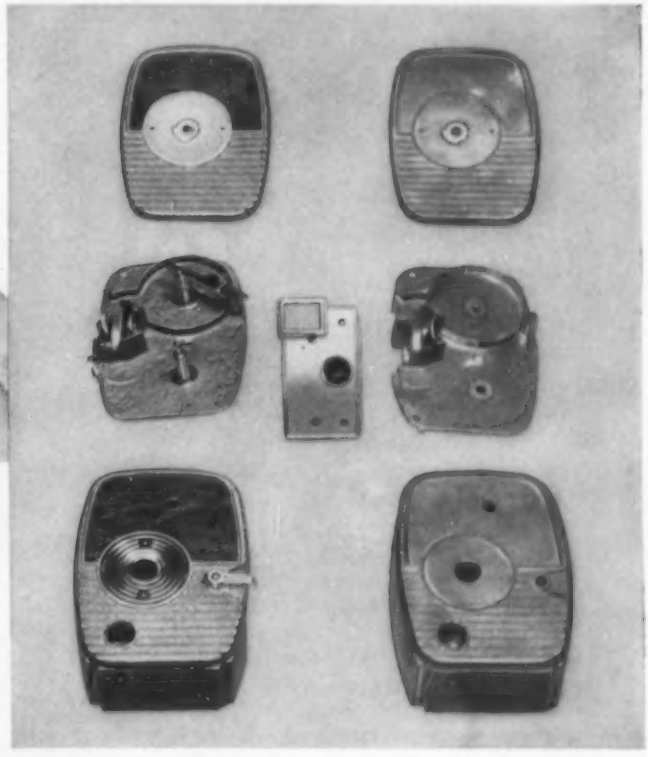
STABLE PRICE ON ZINC is expected throughout 1956, according to Howard I. Young, president of American Zinc, Lead & Smelting Company, in a report to Company stockholders. He also predicted that inventories in the hands of producers should remain near the present levels.

"The most promising index of the zinc Industry's growth is the increase in per capita consumption in the United States," he said. "Expanded uses of zinc in steel galvanizing and the die-cast industry have increased per capita consumption of zinc by 20% in the last eight years. A new high of 13 pounds per capita was set in 1955."

TITANIUM EXTRUSIONS have been delivered by Reynolds Metals Company, completing its first commercial order after more than two years of research and development. This first delivery went to a manufacturer of jet engines. So far the company has worked only on typical sections as a means of studying the economic and technical aspects of titanium fabrication.

DIE CASTING REPORT

Contours, clever design and weight saving... attract light industry



The photographic industry, long a user of aluminum die-castings, is daily finding more ingenious ways of using this cost-and-weight saving process. Look at this Keystone 8 mm Capri movie camera. (1) A cast groove in the cover provides a positive light seal—almost impossible to achieve economically by other processes; (2) the mechanism plate features a cast film guide, a governor housing and cored holes which all simplify and speed assembly; (3) much machining is eliminated by cored holes and part has buffed finish for customer chrome plating, and (4) exceptionally smooth finish on case plus streamlined appearance and detail were possible only with die-castings.

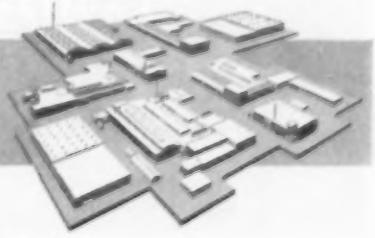
Clever engineering and major use of die-castings enable Keystone to produce a quality, precision camera at a price designed to attract volume sales.

Lawn Spray Nozzle Three core pulls, a 2 impression die, and a production of close to 300,000 zinc units per season. That's the story of this complicated little die-casting. Machining included punch press parting line, facing nozzle end and seat, reaming core flash at junction of two cores, facing hose connection, drilling one pin or shaft hole, and tapping hose thread and plunger cylinder end. All operations done by Precision. An example of perfect integration.

Write on your letterhead for a copy of "Die-Castings...Unlimited." Address: Precision Castings Co., Walnut St., Fayetteville, N. Y.

PRECISION CASTINGS CO.

A DIVISION OF **HARSCO Corporation**

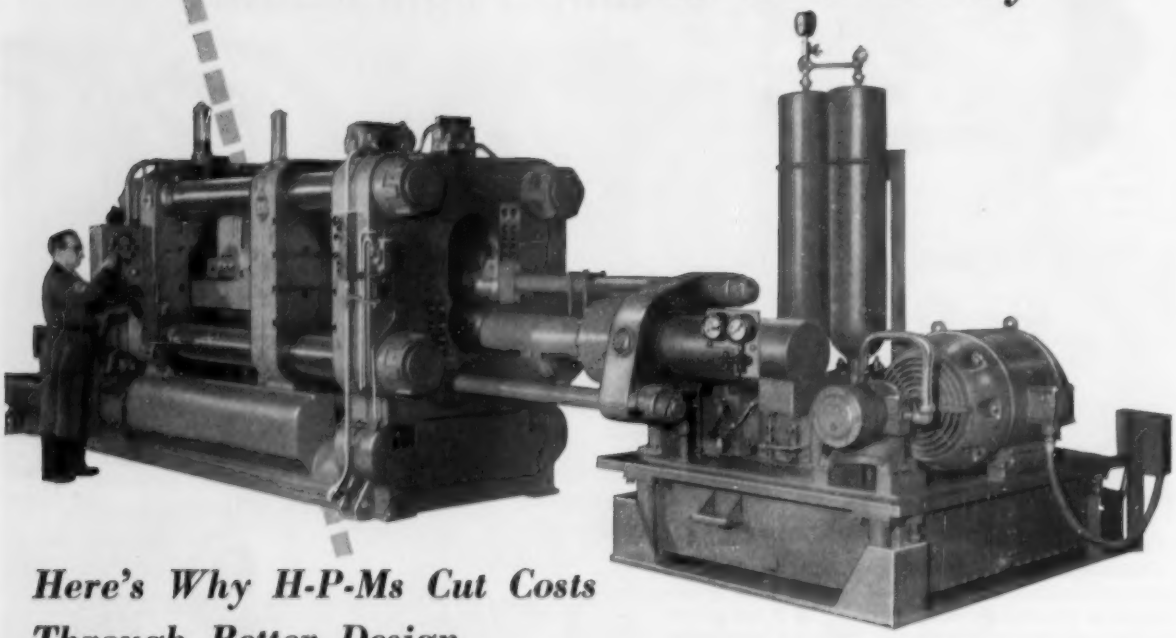


FAYETTEVILLE, N. Y.—SYRACUSE, N. Y.—CORTLAND, N. Y.—NEW YORK, N. Y.
CHICAGO, ILL.—CLEVELAND, OHIO—KALAMAZOO, MICH.

For more information circle No. 89 on the Reader Service Card

IF YOU DIE CAST . . .

H-P-Ms Give You More For Your Money



Here's Why H-P-Ms Cut Costs Through Better Design

H-P-M die casting machines are the answer to many of today's die casting problems . . . production output to meet any job requirement . . . cleaner castings . . . negligible flash . . . parts produced to accurate dimensional tolerances with improved quality and density. H-P-M's new design, mechanical link wedge clamp and new injection end, results in a new approach to die casting techniques. Here's why H-P-Ms are the best buy:

1. MORE "BEEF"—Heavier platens . . . more die support, less deflection. Larger rods . . . reduced flash, less trimming . . . more casting dimensional control . . . less die trouble.
2. MORE PRESS WEIGHT—Compare price per pound . . . you'll have difficulty finding an equal. In addition . . . H-P-M's many new design features.
3. MORE HORSEPOWER—Clamps to the rated tonnage . . . more pressure cycles per hour . . . higher injection speeds and pressures . . . positive and instantaneous injection follow through.
4. MORE SPEED IN DIE SET-UP—Single central screw adjustment changes daylight and controls tonnage . . . no tie rod nut adjustment.
5. MORE PRESS FLEXIBILITY—No die too complicated or sequence too elaborate. Infinitely adjustable . . . complete control of action, both clamp and injection ends . . . speed and tonnage assured when needed.
6. MORE SAVINGS IN MAINTENANCE—Self-contained clamp and injection ends . . . compact hydraulic power units . . . manifolded high pressure hydraulics . . . automatic lubrication . . . simplicity of mechanical link wedge design.

Write for Bulletin 5400-A, today

DIE CASTING DIVISION
THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio U.S.A.

HPM

For more information circle No. 54 on the Reader Service Card

USCO K-Z

USCO K-Z Aluminum Die-Casting Alloy is a high zinc variation of the popular USCO K. In other words, USCO K-Z is an AXS-679 Revision 3 alloy with zinc up to 2% maximum. The physical properties of K alloy are retained in the K-Z alloy, at a price saving to you.

USCO K-Z, like all other USCO Aluminum Alloys, is production and quantometric controlled from raw materials to finished ingot under the most modern methods of alloying and refining—giving you the properties you desire in your castings.

As with all USCO Alloys, if you desire, K-Z can be tailor-made to fit your specific needs.

Let our metallurgical engineers, who have a practical working knowledge of die-casting, aid you in selecting the correct alloy and assist you with your melting and casting problems.

USCO

U. S. REDUCTION CO.
East Chicago, Indiana

PLANTS: EAST CHICAGO, INDIANA • TOLEDO, OHIO

For more information circle No. 103 on the Reader Service Card

DATA OFFERED IN THIS MONTH'S ADS

the Reader Service Cards on the facing page will get you these free reference materials. Circle the numbers and mail.

1. **1000 Shots Per Hour**—according to bulletin A-10, an engineering report on small die casting machines, from ABC Die Casting Machine Co.

3. **Colloidal Dispersions for Casting**—Bulletin 425 from Acheson Colloids Co. describes the different dispersions available for foundry use.

5. **Induction Melting for Investment Casting**—The details of these melting furnaces and engineering reports on their operation are given in bulletins 14-B and 27-B from Ajax Electrothermic Corp.

6. **Alloy Metal Powders**—The use of these powders in the fabrication of parts and the properties of the parts made from them are covered in detailed reports from Alloy Metal Powders, Inc.

9. **Heat Exchangers for Die Casting Machines**—Bulletin 1.1K5 from the Ross Heat Exchanger Div. of American-Standard gives the details of these units as applied to die casting machines.

13. **Die Casting Alloys**—A new booklet "Die Casting Alloys" has been issued by Apex Smelting Co. Mechanical and metallurgical properties of the as-cast alloys are given.

15. **Designing for Investment Casting**—A booklet has been prepared by Arwood Precision Casting Co. that has been especially written for design and production engineers. Design factors, costs, etc. are given.

19. **The Economics of Investment Casting**—Literature has been prepared by W. H. Anderson Co., Inc. showing how the use of investment castings can materially lower production costs.

20. **Refractory Mold Materials**—Literature is available on new mold materials that feature a uniform coefficient of thermal expansion up to 2400F, higher fusion point, and other advantages from Harbison-Walker Refractories Co.

22. **Die Casting Machine Specifications**—The complete specifications on the different models of die casting machines now being built are given in literature from B & T Machinery Co.

27. **Complete Metal Melting Facilities**—Whatever your needs, whether air melted or vacuum melted master alloy or alloy ready for remelt Cannon Muskegon Corp. has the facilities. A new booklet describes the facilities available and the alloys and metal forms that can be supplied.

29. **Safety Hydraulic Fluids**—In a new booklet, Form 7380, the uses and properties of the different Hydrolubes are discussed. Copies can be secured from Carbide & Carbon Chemicals Co.

31. **Wax Injection Equipment**—In bulletin no. 1202, the Centrifugal Casting Supply Co. describes and gives complete operational data on their injection equipment for industrial waxes.

32. **Plastic Patterns**—The advantages, uses and properties of plastics for use as investment casting disposable patterns are discussed in literature from Centrifugal Casting Supply Co.

33. **Permanent Mold Castings**—The advantages of permanent mold castings in aluminum for either large or small parts are discussed in an illustrated brochure from Centr-O-Cast & Engineering Co.

34. **New 600 Ton Die Casting Machine**—In a well illustrated bulletin, Cleveland Automatic Machine Co. describes and gives complete data on their new hydraulic die casting machine.

40. **Sprue Bushings & Spreaders**—Complete specification sheets giving all of the uses and advantages of specially designed, longer wearing sprue bushings and sprue spreaders are available from Detroit Mold Engineering Co.

42. **Vacuum Casting**—The advantages of investment cast parts that have been vacuum cast are described in literature from Engineered Precision Casting Co.

43. **Improved Cutting Oil**—Bulletins describing the many lubricating specialties made by Fiske Bros. Refining Co. are available. One of the newest is a cutting oil for both ferrous and non-ferrous metal machining.

44. **Improved Metal Powders**—Resistox metal powders, said to produce superior bushings and structural parts are completely described in detailed reports from the Glidden Co.

48. **Furnace Refractories**—Complete technical data are available on the several different refractory materials for repairing and lining metal melting furnaces made by Harbison-Walker Refractories Co.

49. **Technical Data Book**—Henning Bros. & Smith, Inc. has prepared a technical data book listing the alloys available together with the chemical, physical and mechanical properties of the alloys in the as-cast condition.

50. **Designing for Investment Casting**—A brochure has been published by the Hitchiner Mfg. Co. that will aid the engineer in designing for the most economical and best use of investment castings.

51. **Die Castings**—A booklet has been issued by the Hoover Co. that describes the production and research facilities of the company that are available to customers.

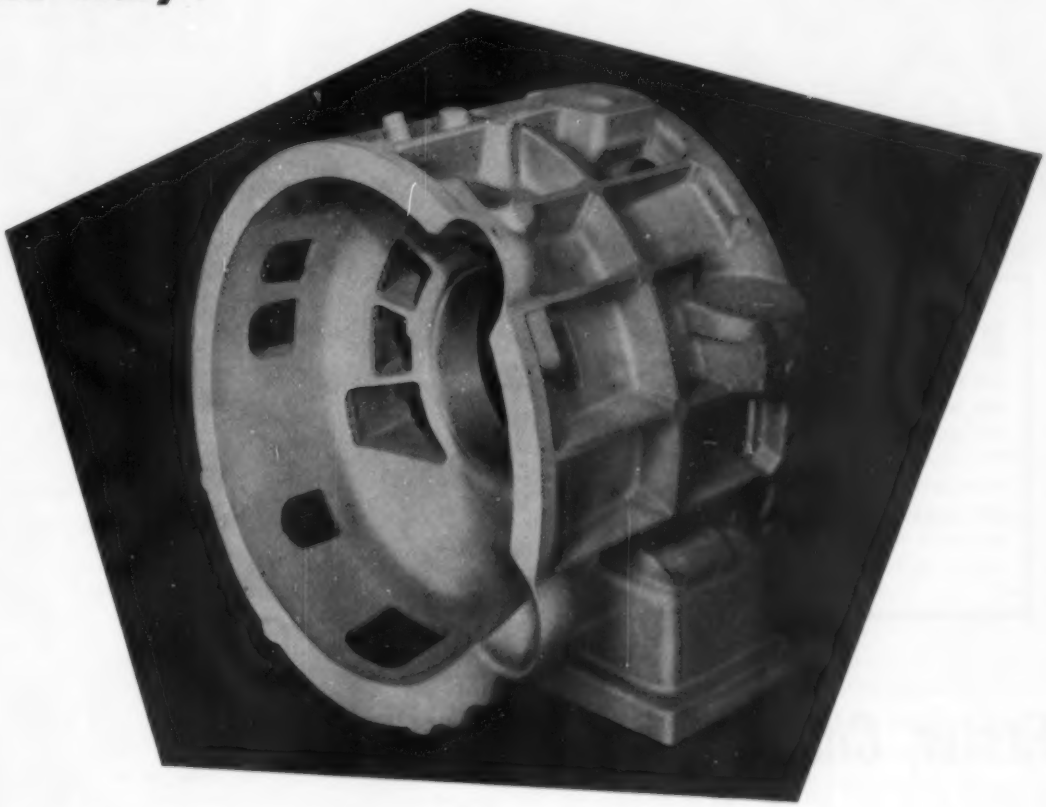
52. **Fire-Resistant Hydraulic Fluids**—Technical data are available from E. F. Houghton & Co. describing their fire-resistant hydraulic fluids and suggesting many places where such materials should be used.

54. **Die Casting Machines**—In bulletin 5400-A, the Hydraulic Press Mfg. Co. describe the different die casting machines made by the company. Complete data on all machines are included.

57. **Investment Castings**—In a booklet, "Cast to Outlast," the International Nickel Co. discusses how production costs can be cut and quality improved through the use of investment castings.

Continued on page 18

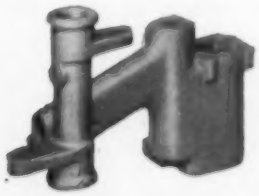
this is the aluminum industrial converter housing they said couldn't be cast this way!



Every company at some time accomplishes a difficult task that brings real satisfaction to everyone. Such is the case with the 65 pound semi-permanent mold casting shown above made for a division of an automotive major. One of our respected competitors said, "It can't be done that way." The casting buyer said, "It's got to be done." We did it, delivered it ahead of schedule, and the costs were right. Everyone was happy about the job.

Centr-O-Cast manufactures a complete range of aluminum castings in the permanent mold, semi-permanent, centrifugal, and centrifuge fields ranging in weights from 2 ounces to 65 pounds. All alloys are used, either regular or heat treated. Operating at the rate of 750,000 pounds of finished castings per month Centr-O-Cast ranks as one of the larger permanent and centrifugal casting foundries in the country.

Next time your drawings call for aluminum we would like to help. A card will bring an illustrated brochure, or, if you prefer, a personal call by our casting consultant.



Small permanent mold aluminum castings which proved that quality need not be expensive.

centr-O-cast

CENTR-O-CAST AND ENGINEERING COMPANY

45 St. Jean Avenue, Detroit 14, Michigan

For more information circle No. 33 on the Reader Service Card

2
1
3
Thousands of these miniature XK120 Jaguars (1) are molded each hour from multiple steel cavities (2). These hobbings are produced rapidly and with a minimum of machining from a single master hob (3).

Faster, Cheaper Tooling with...

NEWARK DIE HOBBED CAVITIES

To speed up tooling and cut costly machining, filing and polishing time . . . many plants choose die hobbing. One master hob provides any quantity of steel molds or dies, all of them exactly alike and each requiring a minimum of hand or machine finishing. Because hobbing is a cold flow, high pressure operation (over 100 tons per sq. in.) each cavity acquires a closer surface grain structure. This assures faithful retention of the finest detail . . . plus a luster that would be difficult to accomplish by machine finishing.

WRITE for your free copy of "How and When to Hob." Or let us discuss directly how Newark's complete die hobbing facilities and experience with all sizes and types of cavities may benefit you. No obligation, of course.

NEWARK DIE HOBBING AND CASTING CO.

20 SCOTT STREET, NEWARK 2, N. J. PHONE MArket 3-3805

For more information circle No. 85 on the Reader Service Card

DATA IN ADS

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58. Investment Castings—The Investment Casting Co. has issued a brochure to help design engineers with their special casting problems.

59. Manual of Investment Casting—A new manual has been prepared by the Jelrus Precision Casting Corp. which describes the investment casting process and gives design and application information.

61. Investment Casting Furnaces—The new type IC furnace with a melting capacity of up to 20 lbs. is described in literature from the Detroit Electric Furnace Div., Kuhlman Electric Co.

62. Die Casting Machines—Kux Machine Co. has issued a complete catalog covering their line of die casting machines. All of the necessary operational and physical data needed is given.

63. Die Casting Machines—In detailed literature, Lake Erie Engineering Co. has described and illustrated their die casting machines.

66. Melting Furnaces—A series of bulletins have been issued by Lindberg Engineering Co. that describe their gas, oil or electrically heated non-ferrous melting furnaces.

67. Designing for Die Casting—Litemetal Dicast, Inc. has published a booklet on designing for die casting.

72. Design & Production of Castings—A 12 page booklet has been issued by Midwest Foundry Co. describing the design and production facilities of the company for making shell mold and investment castings.

73. How to Design Investment Castings—A new booklet that has been published by Midwest Precision Castings Co. to aid the engineer and production man in securing the best design for investment casting.

78. Machine Table—A cross-slide, rotary machine table that is said to reduce set-up time by as much as 90% is described in literature from Morrison Engineering Co.

81. Standard Bearings—National Molded Products, Inc. has issued a listing of standard size bushings and bearings carried in stock. Sizes, load data, etc. are given.

Continued on page 20

For more information circle No. 30 on the Reader Service Card

ALTERNATIVE TO DISASTER . . . fire-resistant oils

Celanese® Cellulubes® are synthetic oils—straight chemical compounds developed by Celanese to minimize the constant threat of fire and explosions inherent in many industrial operations.

As power transfer fluids in diecasting and other critical hydraulic operations, fire-resistant Cellulubes reduce the ever-present danger of uncontrollable fires due to line breaks or other failures. As cylinder lubricants in air compressor systems, these non-petroleum oils prevent the formation of excessive carbon deposits. Result: danger of fires and explosions is minimized and maintenance costs reduced.

Can a Cellulube solve a safety problem in one of your plants? We will be glad to send you complete use data.

Cellulube fire-resistant functional fluids are the result of research working toward a single objective: how to give industry more productive chemical materials. If you're looking for the extra values that can make your operation safer, your production more efficient, or your product more competitive, we think you'll find the Celanese research approach rewarding. Celanese Corporation of America, Chemical Division, Dept. 589-F, 180 Madison Avenue, New York 16, N. Y.

Basic reasons . . . . for improved products

Acids
Alcohols
Aldehydes
Anhydrides
Esters

Functional Fluids
Gasoline Additives
Glycols
Ketones
Oxides

Polyols
Plasticizers
Salts
Solvents
Vinyl Monomers

Celanese® CHEMICALS

®Reg. U.S. Pat. Off.

Agricultural, automotive, aviation, building, electrical, paper, pharmaceutical, plastics, surface coatings, textile.

There's safety in these numbers

UCON Brand **Hydrolube 200-N**
(Viscosity—approx. 200 S.U.S. at 100° F.)

UCON Brand **Hydrolube 300-N**
(Viscosity—approx. 300 S.U.S. at 100° F.)

UCON Brand **Hydrolube 550-N**
(Viscosity—approx. 550 S.U.S. at 100° F.)

Yes, there's safety in the three standard viscosity grades of UCON *Hydrolubes—*CARBIDE*'s safety hydraulic fluids.*

Safety for men and property

- The resistance of UCON Hydrolubes to burning has been proved by years of severe, exhaustive testing in the laboratory. AND, *in actual service*, UCON Hydrolubes have prevented serious fires and injury during their more than 8 years of routine use. UCON Hydrolubes are water-base hydraulic fluids—the water content is the key to their non-flammability.
- And, for all practical hydraulic purposes, UCON Hydrolubes are non-toxic to workmen.

Safety for machines

UCON Hydrolubes

- Have no harmful effects on packings and seals. Leakage losses are often lower than with other hydraulic fluids.
- Contain effective liquid and vapor phase corrosion inhibitors for the common metals.
- Have good lubricity. Special anti-wear agents provide satisfactory pump life and performance characteristics.
- Have high viscosity indexes—150 to 160.
- Have low pour points—can be used at sub-zero temperatures.
- And, are made in the three standard viscosity grades—others can be supplied to fit specific requirements.

For safety's sake, get all the facts. Write *today* for the booklet, "UCON Hydrolubes," Form 7380.

CARBIDE AND CARBON CHEMICALS

CARBIDE AND CARBON CHEMICALS COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

"Ucon" is a registered trade-mark of Union Carbide.

For more information circle No. 29 on the Reader Service Card

DATA IN ADS

continued from page 18

82. Iron Powder Data Sheets—A new data sheet has been issued on the properties and uses of B-261 Plast/Iron powder by National-U.S. Radiator Corp., Plastic Metals Div.

84. Zinc for Die Castings—A brochure has been published by The New Jersey Zinc Co. giving many of the answers to production problems by conversion to zinc die castings.

85. Hobbed Dies—A booklet published by Newark Die Hobbing & Casting Co. entitled "How and When to Hob," discusses the advantages and proper applications of hobbing as a die sinking method.

86. Induction Melting—The advantages and economies of induction melting are discussed in a booklet "The Case for Tocco Induction Melting" that has been published by The Ohio Crankshaft Co.

91. Plunger Rings—A bulletin has been issued by Precision Piston Rings, Inc. describing and giving the advantages of their stainless steel plunger rings.

92. Investment Materials—Investment materials that are said to produce better castings with finer detail and smoother finish are described in technical information from Pre-Vest, Inc. Samples are also available.

93. Cost Cutting with Die Castings—A descriptive brochure has been issued by Paramount Die Casting Co. describing the facilities that are available to help cut costs through the use of die castings.

97. Non-Ferrous Metals—A series of four booklets has been prepared by The George Sall Metals Co. dealing with test bars, leak proof aluminum castings, melting and casting aluminum alloys and machining aluminum.

98. Investment Casting Supplies—A new catalog has been issued by Alexander Saunders & Co. listing and describing their complete line of equipment and supplies for the investment casting foundry.

100. Metal Powder Presses—The F. J. Stokes Corp. has issued three literature items on metal powder presses. Catalog No. 801, bulletin No. 670, and a brochure "Powder Metallurgy Today."

Continued on page 75

TWO LEADERS IN CASTING GET TOGETHER

All die-castings in this famous OCEAN CITY REEL are made by DOLLIN

OCEAN CITY "300" SPINNING REEL

One of the most popular spinning reels on the market, featuring over 20 important advantages for fresh and light salt water casting. The "300" combines strength, durability, precision and lightness through scientific design and liberal use of aluminum and zinc die-castings by Dollin, as shown below.

Make DOLLIN your source for Quality Die-castings, at low cost

LARGE PARTS. Aluminum castings made on large cold chamber type, high pressure machines. Large zinc castings made on large plunger type machines.

SMALL ZINC CASTINGS. 1000 per lb. to 3 per lb., made on fully automatic machines. More design latitude, attractive tool costs, low piece prices.

Manufacturers of America's top-brand products in every field rely on Dollin's advanced engineering and production techniques for high-volume, accurate die-cast parts, at lowest possible prices.

Best way to learn what Dollin can do for you, is to submit prints or samples of your present or proposed parts for engineering advice and quotation, without obligation.

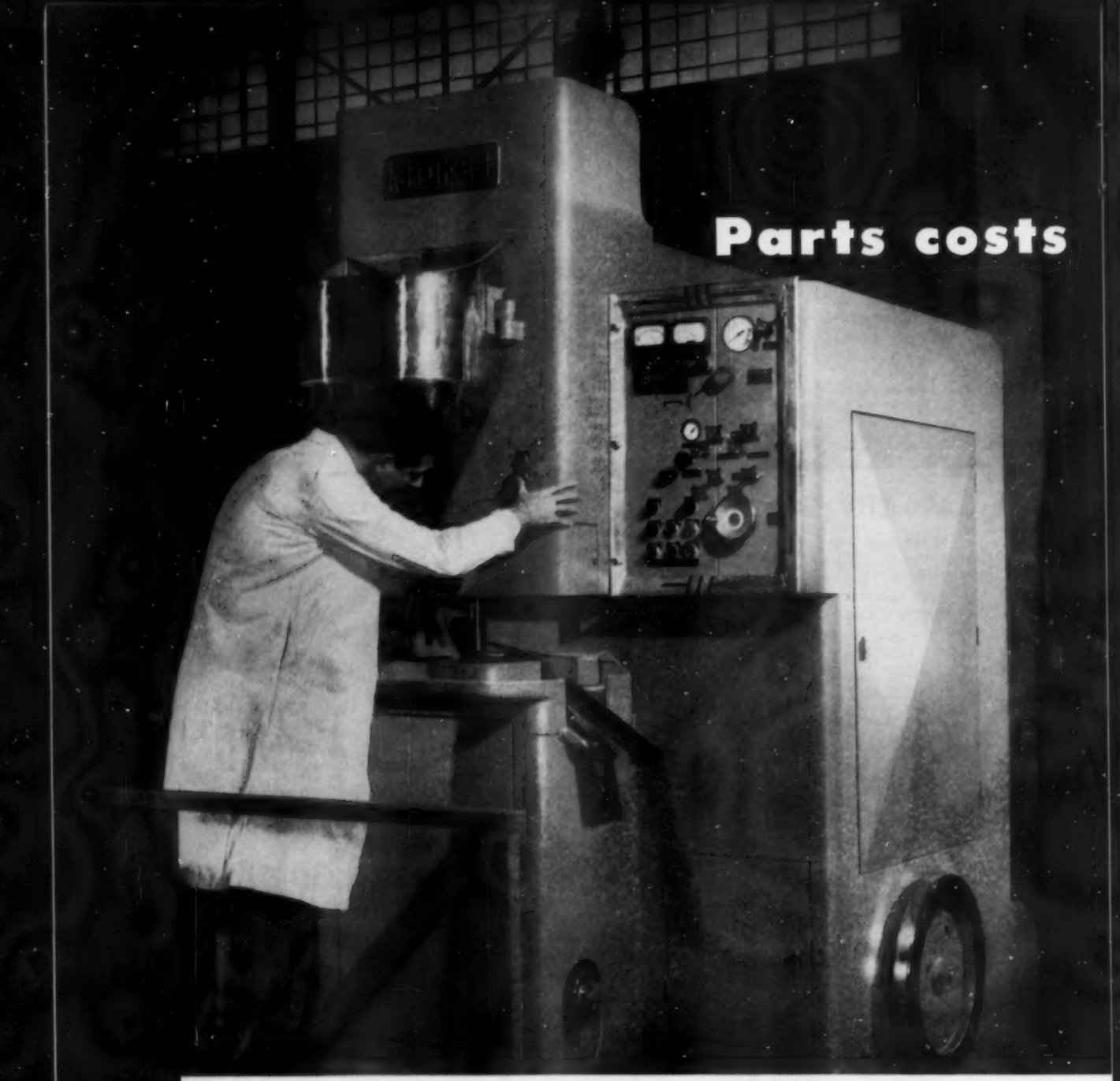
Dollin Corporation 614 So. 21st St., Irvington 11, N. J.

SALES OFFICES: Boston • Buffalo • Canton • Charlotte • Chicago • Detroit • Louisville • Philadelphia • Pittsburgh • St. Louis • St. Paul

DOLLIN Zinc and Aluminum **DIE-CASTINGS**

For more information circle No. 41 on the Reader Service Card

Parts costs



Typical parts being produced on Stokes Model 640 Press by International Business Machines Corporation.

Feed pawl cost cut 64.6%
Sintered iron Tolerances:
thickness ±.002"
centerline to tip ±.002"
hole +.001", −.000"

Roll bearing cost cut 46.6%
Sintered bronze Tolerances:
O.D. +.000", −.001"
Bore: +.001", −.000"
Length: ±.001"

Ratchet cost cut 49.3%
Sintered brass Tolerances:
tooth form ±.002"
bore: +.002", −.000"

cut up to 65% at I.B.M.

—by compacting on STOKES powder metal press

On a Stokes 50-ton Model 640 press, International Business Machines Corporation produces a variety of powder metal parts at its Endicott, N.Y. plant. Close tolerances are maintained and costs are reduced up to 65%.

This is typical of the savings that powder metal processing can effect. On Stokes fully automatic compacting presses, many parts which are wasteful of metal stock, machine time and labor when made by conventional methods can be produced in high volume . . . at low cost. This technique applies to a wide range of metals, alloys and non-metallic powders . . . either pure or mixed. It often provides qualities unobtainable in the solid metal.

35 years experience in this field is the foundation for these outstanding features of the Model 640 press . . . latest addition to the extensive Stokes line of compacting equipment.

Easy setup and control . . . press adjustments operate independently, and are centralized at the front of the press. Handwheel calibrations are direct reading.

Precise tool alignment . . . protects tools, assures precision.

Clean operation . . . totally enclosed construction.

Full pressure breakaway at initial ejection eliminates possibility of pieces fracturing. All parts are fully supported during ejection; thin-flanged parts won't break.

Low maintenance, maximum safety . . . *plus great flexibility.*

Find out for yourself how Stokes powder metal pressing can cut parts costs. The Stokes service includes laboratory compacting of samples parts, accurate cost analysis, and design and production of punches and dies. Write today for the following literature: "Powder Metallurgy Today"; Catalog No. 801, "Stokes Powder Metal Presses"; Bulletin No. 670, "Stokes Model 640 Powder Metal Press."

Powder Metal Press Division

F. J. STOKES CORPORATION

5514 Tabor Road, Philadelphia 20, Pa.

STOKES

These leading custom producers profit from Stokes powder metal presses.

$25,000 yearly saved . . . $30,000 machine tool outlay avoided . . . by making lock parts on a Stokes press at Dixon Sintaloy, Inc., Stamford, Conn.

$20,000 per year cost-reduction was made on a wringer drive gear of iron and copper powder, for use on "Whirlpool" washers. Parts made by the Presmet Corporation, of Worcester, Mass. . . . on Stokes powder metal presses.

82% drop in cost is the story behind this drive gear for a home ice cream freezer . . . formed in a single operation on a Stokes press at Yale & Towne's metal products division, Franklin Park, Illinois.

For more information circle No. 100 on the Reader Service Card

3 ways Glidden helps you produce better METAL POWDER PARTS

Superior metal powders — Glidden Resistox Metal Powders have been subjected to the most exhaustive tests by parts manufacturers. Result: parts made from Glidden metal powders are judged superior to parts produced from other powders. They permit faster production, with greatly improved finish, appearance and performance characteristics.

Complete field service and lab facilities — Whether you are interested in establishing a new metal powder parts department, or desire to improve operations of an existing department, Glidden can help you. The Glidden metal powders lab and the services of Glidden technicians are available to your metallurgists at any time.

World's largest blender — Glidden can produce up to 30,000 pounds of powder in one batch, more than any other producer... an important factor in complete uniformity of mass-produced parts.

A thorough examination of the manufacturing methods you are now using may lead to substantial savings. Make certain you are not passing up the economies, speedier fabrication and superior parts performance you can get by using Glidden Resistox Metal Powders. Write for complete details.

THE GLIDDEN COMPANY

Chemicals — Pigments — Metals Division

Baltimore, Md. • Collinsville, Ill.
Hammond, Ind. • Scranton, Pa.

QUALITY Glidden PRODUCTS — CHEMICALS PIGMENTS METALS

For more information circle No. 44 on the Reader Service Card

BETWEEN THE LINES

the editor's viewpoint on articles in current and forthcoming issues

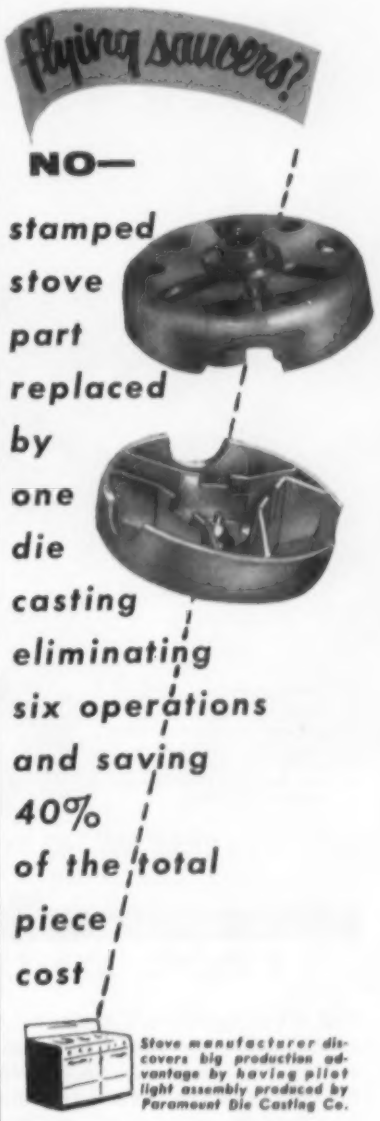
HOW MUCH WILL IT COST YOU to buy investment castings poured under vacuum? Not as much as you might think. Some comparative figures worked out by metallurgist Kenneth Iverson show that you can probably get the favorable properties of the vacuum cast metals at *less than double* the cost of air melted castings. His report on this timely subject, including drawings and operating details of a new furnace designed especially for vacuum investment casting, starts on page 130 of this issue. Many leading investment casters agree that vacuum casting holds the key to future expansion of the investment casting process, especially in the field of aircraft components.

ONE OF THE ANCIENT CERAMIC PROCESSES can now be used to form powdered metal parts. The favorable properties of this material can thus be applied to components that do not lend themselves to the conventional pressing technique. Slip casting of powdered metals will be reported in an article scheduled for PMM in July. Watch for it.

NON-ELECTROLYTIC NICKEL-PHOSPHOROUS COATINGS that are completely uniform and non-porous can be deposited over iron powder parts or aluminum castings. Already, one major die caster, and several users of powdered metal parts have made a preliminary investigation of this process. What this process offers you toward improved surface protection can be learned from an article beginning on page 66.

BUYER'S GUIDE to the investment casting industry is a key feature in this issue. You'll want to keep this directory handy throughout the year when you want to find sources of castings or equipment and materials. Investment casting, not many years ago comprised of a handful of moderate-sized shops, has suddenly emerged as a major metal fabricating industry. This Investment Casting Directory is the first compilation of companies, products and technical data ever published. Note: If there are other people in your organization who should have copies, we are having extra copies printed. Prices of extra copies are printed on the Table of Contents page.

THE LURE OF THE OUTDOORS GOT US, and we couldn't resist putting together a section showing where PMM components are being used in the equipment found around the garden and yard. See it beginning on page 49. It includes lawn mowers, garden tractors, cultivators and a number of other handy tools.


flying saucers?
NO—
stamped stove part replaced by one die casting eliminating six operations and saving 40% of the total piece cost

Stove manufacturer discovers big production advantage by having pilot light assembly produced by Paramount Die Casting Co.

Here again Paramount engineers have reproduced an already developed article by die casting methods—saving over 40% in production cost over former stamped assembly methods. Thoroughly experienced in all phases and techniques of die casting—a Paramount engineer can help you cut costs by developing original designs or redesigning your present products to the die casting process.

WRITE FOR FREE DESCRIPTIVE BROCHURE

ALUMINUM ZINC MAGNESIUM

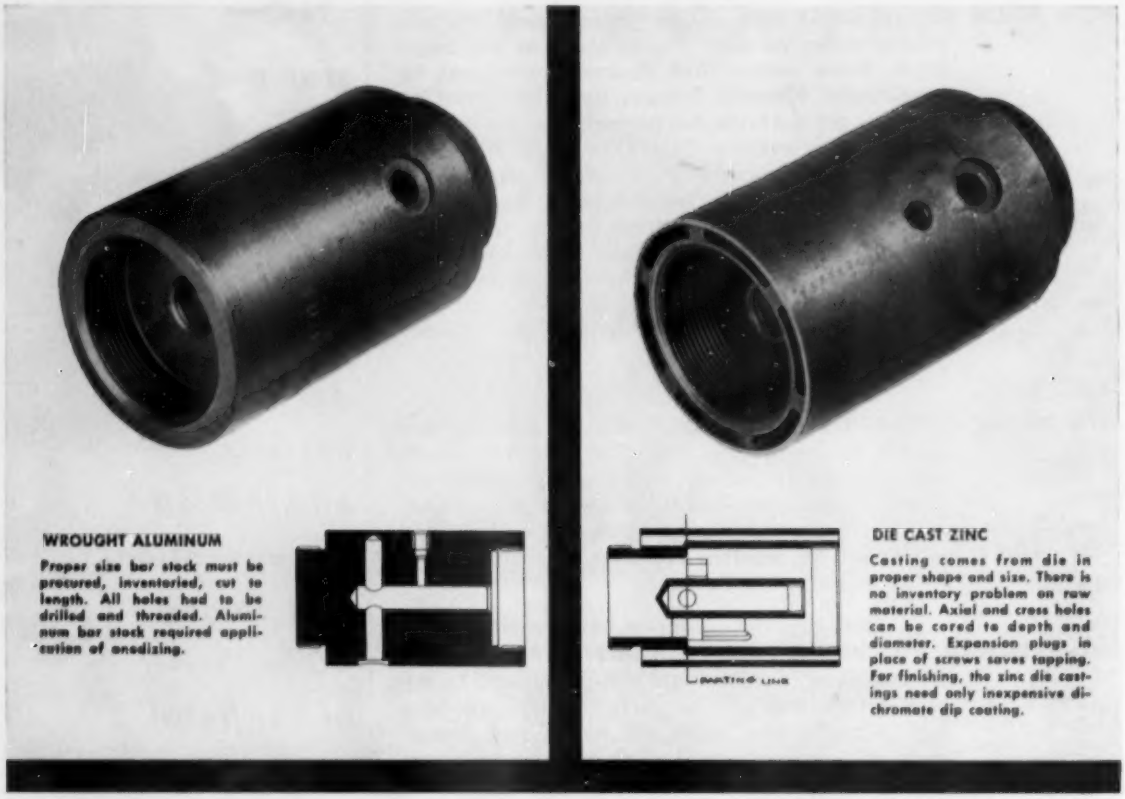
Paramount DIE CASTING COMPANY

St. Joseph 10, Michigan

Circle No. 93 on the Reader Service Card

ROCKET FUSE IS REDESIGNED FROM WROUGHT ALUMINUM TO DIE CAST ZINC. RESULT:

50% cost reduction
No increase in weight



WROUGHT ALUMINUM

Proper size bar stock must be procured, inventoried, cut to length. All holes had to be drilled and threaded. Aluminum bar stock required application of anodizing.

DIE CAST ZINC

Casting comes from die in proper shape and size. There is no inventory problem on raw material. Axial and cross holes can be cored to depth and diameter. Expansion plugs in place of screws saves tapping. For finishing, the zinc die castings need only inexpensive dichromate dip coating.

Illustrations courtesy of MATERIALS & METHODS

THE SPECIFIC GRAVITY of zinc being 2.4 times that of aluminum, this re-design of an airborne component presents an interesting turnabout. The switch from aluminum bar stock to die cast zinc in the manufacture of the rocket fuse owes its success to the nature of the die casting process. It permits placing the metal where it is needed, eliminating it where it is not. Thus, coring of the zinc die casting has reduced the volume of the fuse body, and the weight was held to 6155 grains—the same as that of the aluminum product it replaces. By producing the fuse as a cored zinc die casting rather than turning it on a screw machine from aluminum bar stock, the following operations were eliminated: 1) cut off, 2) drilling three holes, 3) threading two holes, and 4) anodizing. The zinc die casting requires the following operations subsequent to ejection from the die: 1) trimming flash, 2) cutting two threads, and 3) dichromate dip.

The change, made by Monarch Governor Co. of Willow Run, resulted in a 50% cost reduction. Production rate has been increased from 100 aluminum to 150 zinc die cast fuses in the same amount of time.

DIE CASTING is the Process ZINC the Metal BUNKER HILL the Preferred Zinc

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99.99+%

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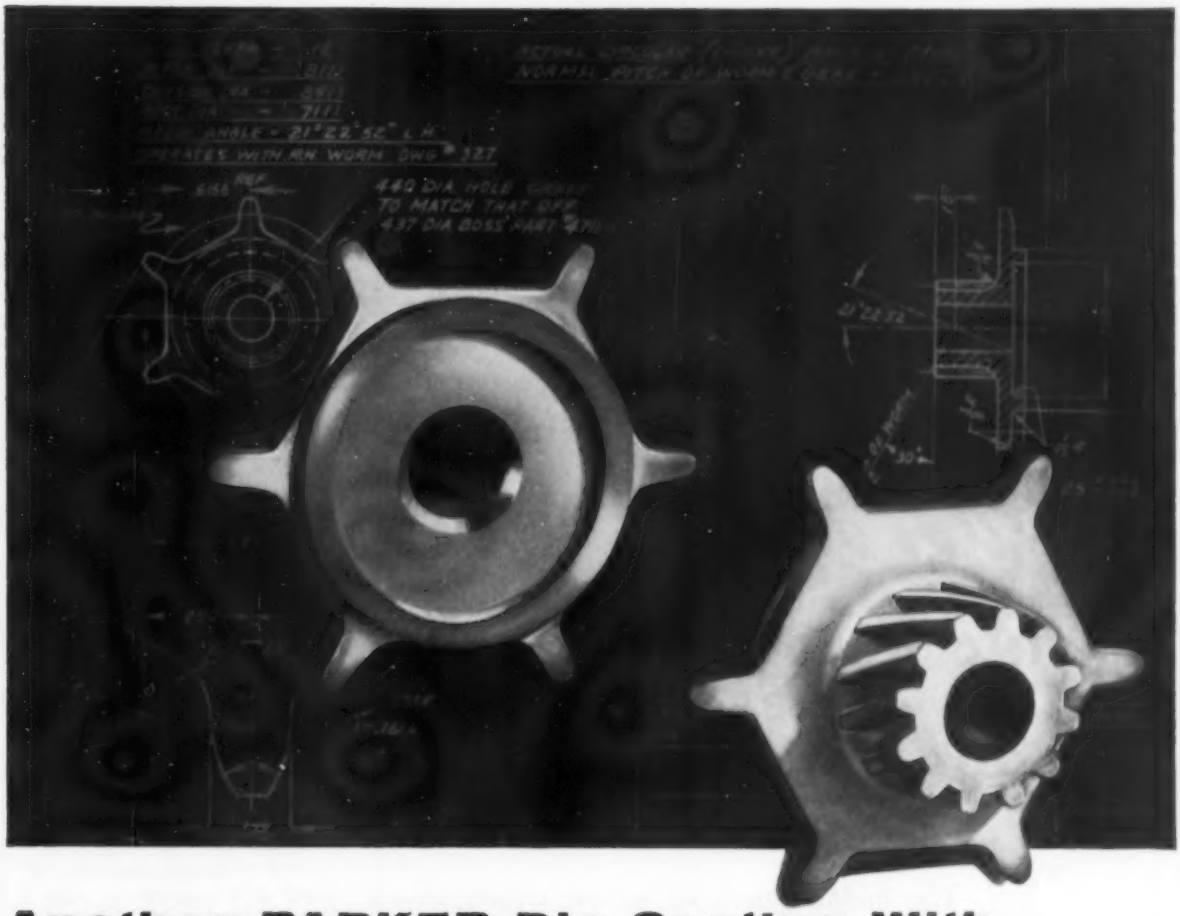

Another PARKER Die Casting With... MACHINED PRECISION at DIE-CASTING COST!

Produced complete in one operation . . . to extremely close tolerances . . . this helical gear part is yet another example of the way Parker-engineered die castings can save you money by eliminating costly tooling-up and machining operations on component parts. Combine this inherent cost advantage with exceptionally smooth as-cast finish, high density and good tensiles and you can see why Parker Die Castings—in zinc or aluminum—open up wide new possibilities to the design engineer.

Parker has been a leader in die-casting for 50 years—an old hand with new ideas. Take advantage of this skill. Just call the nearest Parker sales engineer or write the factory direct.

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PARKER

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Ask for one or all of these booklets . . .

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2304 E. BUTLER ST., PHILA. 37, PENNA.

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PMM LETTERS

the readers' forum

CAN THESE HOLES BE CORED?

At the present time one of our most pressing engineering problems in the field of hydraulic controls is that of designing and producing stainless steel control valve bodies with interior passages. In the past we have made aluminum valve bodies with internal coring, but due to higher operating temperatures (600° F) that are now being encountered, it is necessary for us to go to stainless steel.

This change in material presents many difficulties in coring that have not heretofore been encountered. The following list will give you some idea of the problem.

Interior coring is a must. The drilling of passages causes turbulence and pressure drop of the hydraulic fluid.

As the coring will be used in a casting of 420 stainless, the melting point of which is 2700° F, the coring must withstand this temperature with little or no deforming during casting.

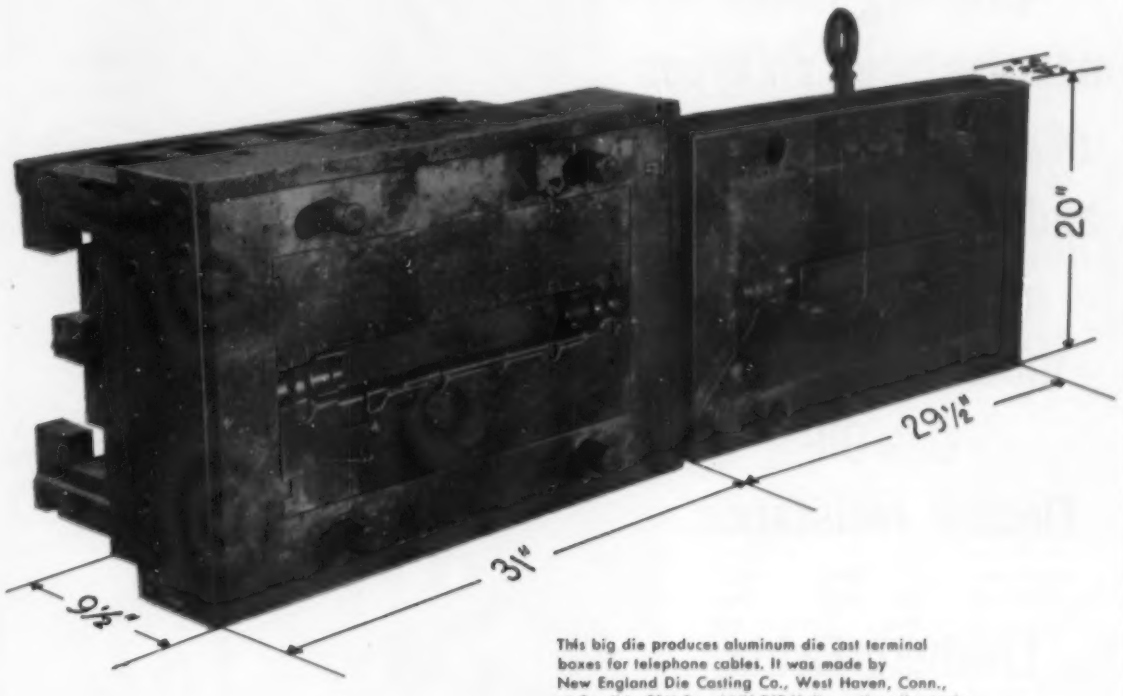
Complete removal of the core must be accomplished by chemical means (removal of the core by mechanical means is impossible) without damaging the casting.

We are interested in rod sizes from 1/16″ Dia to ½″ Dia and in special shapes with total dimensions up to 3″ x 3″ x 4″.

We would appreciate your help in supplying us with any information in regard to articles or publications on this subject and concerns that we may contact. J.N.H.

This is a real tough one, and we have referred this problem to manufacturers of materials for the investment casting industry which encounters problems of this type, especially in its aircraft work. We have seen examples of small diameter holes cored in the higher temperature alloys. In at least one instance, a slender wire reinforcement in the center of the core held it firm against the flow of molten metal, and also

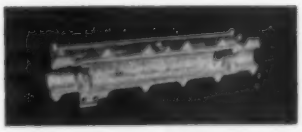
Continued on page 33



This big die produces aluminum die cast terminal boxes for telephone cables. It was made by New England Die Casting Co., West Haven, Conn., of Crucible CSM 2 and NU DIE V die casting die steels.

it's made of

ultrasonically inspected



CSM 2 and NU DIE V

...from Crucible warehouse stock

The die above, built by New England Die Casting Company, West Haven, Connecticut, casts aluminum electrical terminal boxes. The holder block is prehardened CSM 2 – the insert NU DIE V – both promptly obtained from local Crucible warehouse stocks.

Crucible CSM 2 and NU DIE V are made for and inspected to die casting steel quality. They're an unbeatable combination – perfect for holder blocks, solid dies, inserts or sleeves – for any die casting application.

What's more, delivery is from local warehouse stock – in 438 sizes – 1" to 40" wide . . . ¾" to 15" thick – all ultrasonically inspected. You just can't beat Crucible die steels for quality or availability. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

For more information circle No. 36 on the Reader Service Card

Lindberg-Fisher manufactures all types of Aluminum Melting and Holding Furnaces for permanent mold application— Gas-Oil- Electric resistance.

Lindberg-Fisher engineers can intelligently recommend the type of furnace to best suit your needs and conditions.

Melting specialists for 25 years
Sales and service offices in principal cities

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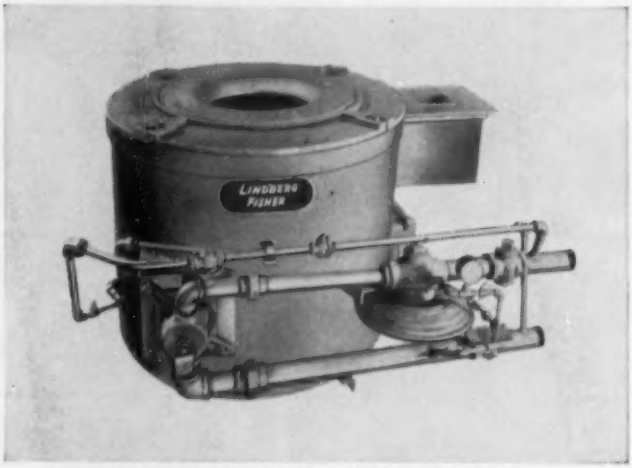
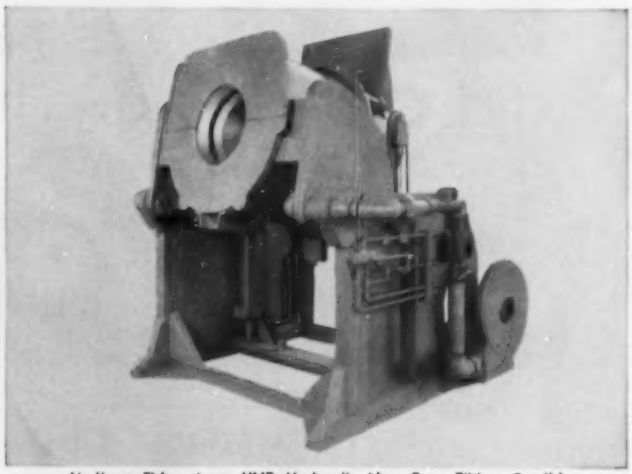
MELTING FURNACES

A Division of Lindberg Engineering Company,
2463 West Hubbard Street, Chicago 12, Illinois

Lindberg-Fisher Electric Resistance Aluminum Melting and Holding Furnace equipped with heavy duty resistance elements which give uniform distribution of heat, insuring long element and pot life. Capacities up to 1000 lbs. Described in Bulletin 320.

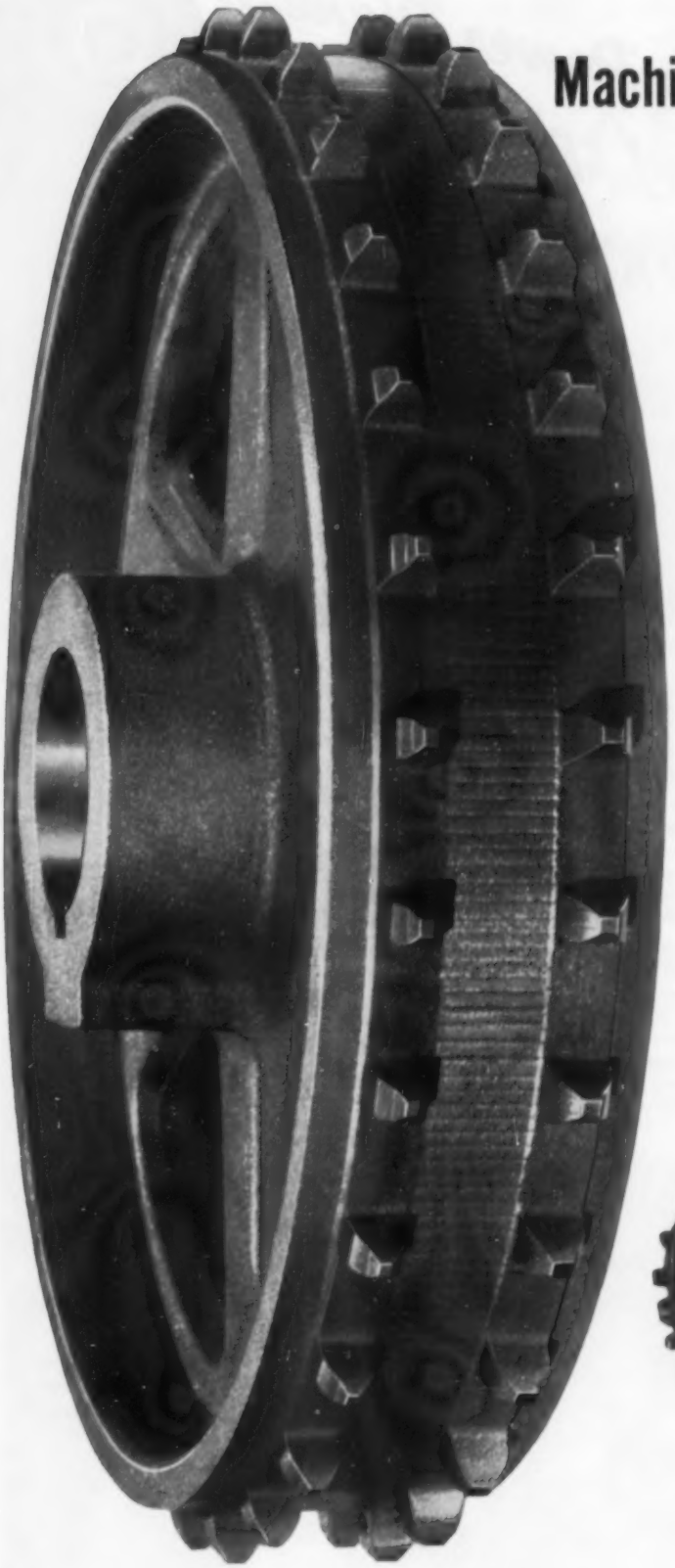


Lindberg-Fisher type ADC Aluminum Melting and Holding Furnace. Capacities up to 1000 lbs. of aluminum. Oil or gas fired. Described in Bulletin 301.



Lindberg-Fisher type HNP Hydraulic Nose-Pour Tilting Crucible Furnace. Pouring lip is located in the axis of tilting providing a constant pouring arc regardless of degree of furnace tilt. Capacities up to 1000 lbs. of aluminum. Oil or gas fired. Described in Bulletin 57-A.

For more information circle No. 66 on the Reader Service Card



Machining these teeth 100% eliminated by shell molding with Plenco resins

Tensile strength increased over results obtained by former casting method

These three ductile iron conveyor drive sprockets were shell molded by Woodruff & Edwards, Inc., Elgin, Ill., a general foundry which has pioneered in this new process.

Through the use of quality Plenco Phenolic Shell Molding Resins, the foundry has effected a notable product improvement. Previously a malleable gray iron blank was cast, requiring the teeth to be completely machined on. Shell molding also allows Woodruff & Edwards to replace gray iron with tougher, more flexible ductile iron, which has greater tensile strength.

Machining of the sprocket teeth (shown nearly actual size at the left) has been eliminated, and the only machining necessary is a reaming of the center bore and removal of the gating ring. Not only are the shell-cast teeth stronger, but the sprockets are produced with savings in labor and material.

We'll be pleased to consult with you on the use of Plenco shell molding compounds in *your* production.

Sprockets are approximately 11, 7, and 4" in diameter and weigh 25, 14 and 8 pounds respectively. All have teeth identical in size.

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

See the Plenco exhibit
7th NATIONAL PLASTICS EXPOSITION
New York Coliseum, June 11-15

For more information circle No. 88 on the Reader Service Card

Never before on a Power Plane... a motor that spins at 25,000 RPM!

CASE HISTORIES FROM MT. VERNON FILES

No power plane before this Porta-Plane has ever used such a high speed motor. And when any manufacturer is out to break all precedents, and still sell his product at a low price, he needs every bit of designing and production skill he can find—anywhere.

This manufacturer found these in generous abundance at Mt. Vernon. The 8 principal parts of the frame of the Porta-Plane were designed to obtain the special advantages of die casting: thin wall sections of great strength and rigidity, negligible machining, smooth finish, high speed production, low cost.

This important advantage—low cost—stems directly from the way we are organized here at Mt. Vernon. From die cast to finished casting, Mt. Vernon has both the complete die casting service and the facilities it takes to produce parts like these at minimum cost in any quantity. We have 162,000 square feet of the most modern equipment for making dies and for die casting aluminum and zinc. Mt. Vernon service comprises completely coordinated designing, die-making, casting, and machining, all under one roof.

It will pay you to bring your production specifications to us. We may show you, as we did Porter-Cable, the way to important cost reductions and improved products.

MT. VERNON
DIE CASTING CORP.
STAMFORD, CONNECTICUT

For more information circle No. 79 on the Reader Service Card

LETTERS

continued from page 28

helped in removing the material from the cast hole.

However, if any PMM reader has a better solution for this problem, drop us a line.—Ed.

DESIGN POINTERS FOR DRAFTSMEN

In the April issue of Precision Metal Molding is included a graphic portrayal of "Design Pointers" in which we are particularly interested.

We would appreciate advice at your earliest convenience whether or not ten additional copies of the graphs in the April issue could be made available to us. We would like to place this information in the hands of our design and detail draftsmen, with a couple of spare copies for shop and inspection use.

Will you please advise the possibilities of obtaining these additional copies.—C. D. W. (Factory Manager)

Extra copies have been forwarded. Judging by the reader reaction, there has been a great need for this type of data, and our supply of extra copies is almost exhausted. The same is true of the design pointers for powder metallurgy published earlier by PMM.—Ed.

SMALL, PROTOTYPE ALUMINUM CASTINGS

In our engineering department, we frequently have need of small intricate aluminum sand castings for experimental or prototype work on precision electro-mechanical computers. Invariably the quantity is small, usually not more than a dozen, and the required consultation time is fairly high. No promise can be made to the vendor for production orders.

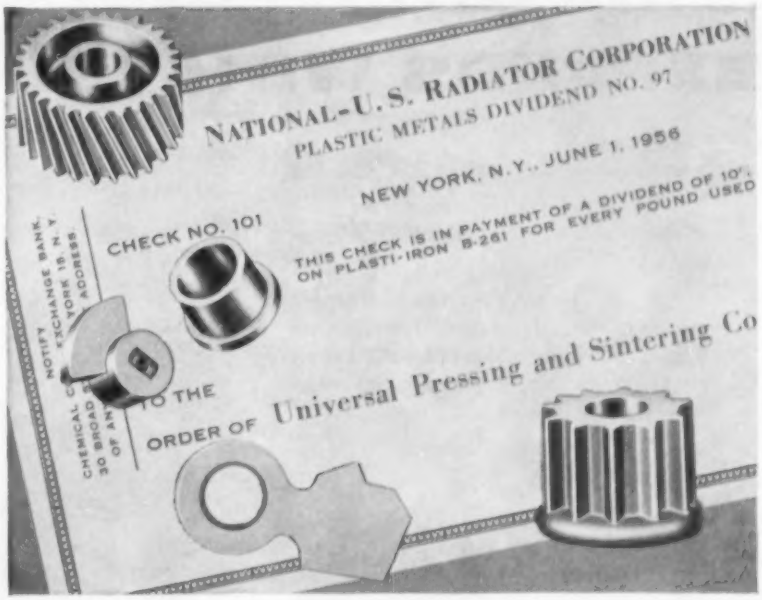
Our experience indicates that many foundries avoid orders of this type as the work is naturally not as profitable as long runs of production items. We recognize the fact that the price on a pound basis is much higher for shortrun experimental work involving close tolerances, material certification, and careful inspection, and consequently we are willing to pay accordingly.

Continued on page 75

like an extra dividend

....cost savings with

PLAST/IRON POWDERS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NOW... *A Die Casting Machine that*
EXPANDS WITH YOUR NEEDS

- Available in capacities of 250, 450, 650 and 850 tons.
- Hot chamber or cold chamber models as desired.
- All models are equipped with an improved version of the highly successful Wedge Cam Toggle. The incorporation of knuckled joints eliminates the use of pressure pins when under locking pressure.

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- Buy the unique Lake Erie Series D "expandable" Die Casting Machine as a basic tool with only the essentials required for your present production. This saves money . . . yet gives you rugged characteristics and top quality never before obtainable in a simplified machine. Incorporated in all models of the new Series D are:

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OPTIONAL EQUIPMENT

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As you get into different types of production, you add any of the following features you need. They can be installed fast, at low cost, right in your plant.

- Multiple Corepull Valving
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WRITE FOR DETAILS

Send today for Circular 255 describing this new and unusual "expandable" Die Casting Machine.

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520 Woodward Avenue, Buffalo 17, N. Y.

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NUMBER 2 OF A SERIES

PRODUCTION SHORT CUTS WITH

ZINC

DIE CASTINGS . . . . .

SEWING UP A PRODUCT DESIGN AT SINGER

Part of the story behind the development of the Singer Automatic Zigzagger (an attachment for use with Singer sewing machines) reveals how—through the use of ZINC Die Castings—efficiency and economy can go hand-in-hand. The castings in the new assembly are shown at the right.

The first consideration in developing the Zigzagger was to establish a basic design which would permit milady to simply and efficiently create a variety of decorative effects merely through the interchange of different stitch patterns. The ultimate design called for some unusually shaped components which led Singer engineers to the specification of ZINC Die Castings. These parts are the cover frame, two presser bar seats and the eight interchangeable stitch patterns.

The economy of die casting the Zigzagger components stems from high speed multiple-cavity production, achieving dimensionally accurate, ready-to-assemble parts. The eight stitch patterns are cast with the sewing design engraved on each pattern head and, as can be seen in the underviews, unusually shaped cam tracks also are obtained on these castings. The smooth surfaces of the ZINC Die Cast cover frame require little preparation for a handsome paint coating.

For possible answers to *your* production problems, send for our brochure and contact any commercial die casting company.

Send for your copy.

The New Jersey Zinc Company, 160 Front Street, New York 38, N. Y.

ZINC
FOR DIE CASTING ALLOYS

The Research was done, the Alloys were developed, and most Die Castings are based on

HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

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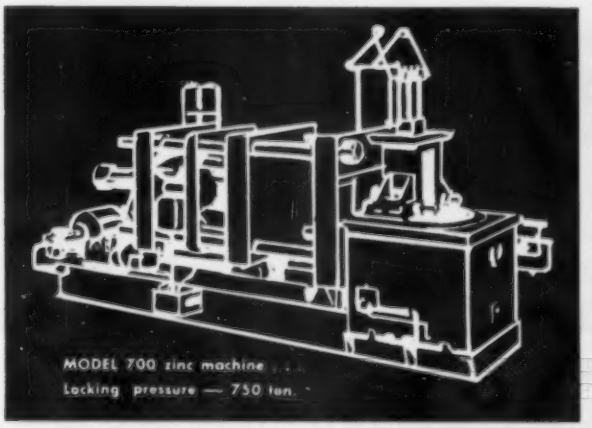
B&T DIE CASTING MACHINES

9 PROVEN MODELS

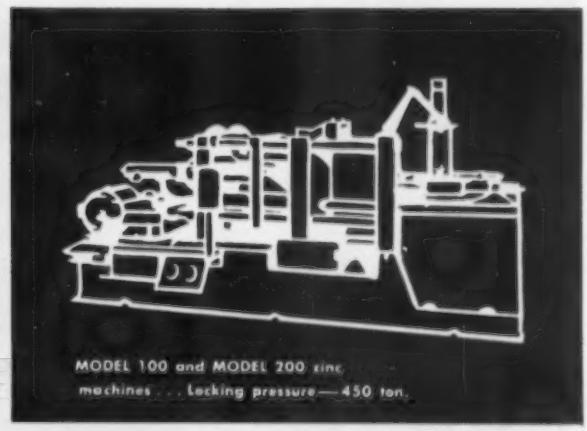
RANGING IN CAPACITY FROM 100 to 750 TONS — FOR ZINC, ALUMINUM, MAGNESIUM and BRASS

DESIGNED AND BUILT TO THE SPECIFICATIONS OF PRACTICAL, LONG-TIME DIECASTERS AND DEVELOPERS OF . . .

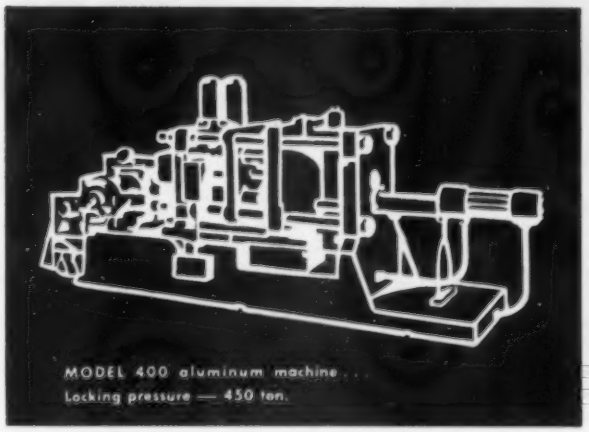
DIE CASTING MACHINES



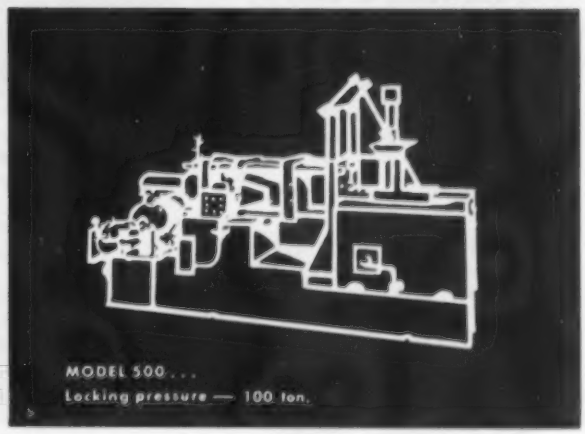
MODEL 700 zinc machine . . . Locking pressure — 750 ton.



MODEL 100 and MODEL 200 zinc machines . . . Locking pressure — 450 ton.



MODEL 400 aluminum machine . . . Locking pressure — 450 ton.



MODEL 500 . . . Locking pressure — 100 ton.

DETROIT OFFICE:
112 MADISON AVE.

B&T die casting machines operate with four extra heavy alloy steel casting toggles that lock directly under the tie bars. The hydraulic lines are of extra heavy seamless pipe; Weldon joints, flanged connections and "O" ring seals on pressure lines. Full specifications on all models furnished upon request. Consult with us on your requirements.

B&T MACHINERY COMPANY 201-217 EIGHTH ST. HOLLAND, MICHIGAN Phone 2341

PRECISION BUSS MACHINERY

AN AFFILIATE OF BUSS MACHINE WORKS · MANUFACTURERS OF MACHINERY SINCE 1862

For more information circle No. 22 on the Reader Service Card

GRC DIE CASTS MOVABLE PARTS IN ONE UNIT, RESULTING IN BETTER DESIGN, LOWER COST

This GRC "Intercast" swivel ring on left cast—this assembled complete in single operation. Ring on right required assembly of two screw machine parts plus a metal stamping.

Intercast, exclusive GRC cast-assembly process produces single units or continuously interlocked assemblies, ready for use.

Previously, Metalcraft Corp., leading manufacturer of picture frames needed *two screw machine parts, a metal stamping plus two assembly operations* to complete their picture frame swivel rings. With Gries "Intercast" production, *a single automatic operation casts the unit completely* assembled, trimmed, *and ready for use.* Metalcraft eliminated assembly entirely, *effected economies of over 50%* and received a more attractive component.

"Intercast" is only one of the exclusive Gries die-casting techniques and processes that offer industry drastic reductions in production costs and new opportunities for improved design. Unique GRC machines turn out simple or intricate small parts, complete, in one high-speed automatic operation. Many manufacturers have found that Gries facilities give them a better product while reducing costs and eliminating machining and assembly operations.

Gries small zinc alloy die cast parts are made to fit size, shape and tolerance specifications *precisely.* Smallness is unlimited (maximum weight ½ ounce, maximum length 1¾ inches). All are mass-produced at low cost in quantities of 100,000 to many millions.

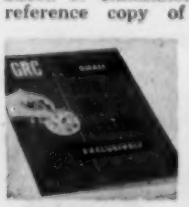
Send for further information on "Intercast" and other Gries small-parts production facilities, and find out how they can be applied to your particular problems.

Wide Variety of Stock Parts Available from Gries

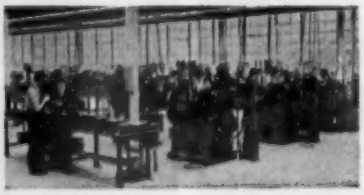
Zinc-alloy and plastic molded products and components covering hundreds of industries can be obtained from GRC. Industrial fasteners such as wing nuts and cap nuts, are produced in great volume, along with saddlery, awning, drapery and window hardware items, nylon coil bobbins, washers and valve seats; die-cast gears and pinions in hundreds of standard combinations. Many other specific parts available; write for full information today.

GRC Gives Help on Design and Production Problems

To learn how designs can be simplified and assembly operations reduced or eliminated, write for useful reference copy of Gries' fact-filled bulletin. In addition, Gries' staff is available to manufacturers for personal consultation on design and production of GRC automatically die-cast and plastic - molded small parts.



GRC Offers Extensive Facilities



In the modern Gries plant, complete production facilities for small precision parts, plus a highly qualified engineering staff, guarantee the manufacture of even the tiniest, most intricate components to exact specifications. In addition to complete production tooling and design development, comprehensive facilities are available for secondary operations . . . machining, tapping, threading, assembly, etc. Practically all commercial finishes can be applied in the complete Gries plating department.

WORLD'S FOREMOST PRODUCER OF SMALL DIE CASTINGS

GRIES

GRIES REPRODUCER CORP.

157 Beechwood Ave., New Rochelle, N. Y. NEw Rochelle 3-8600

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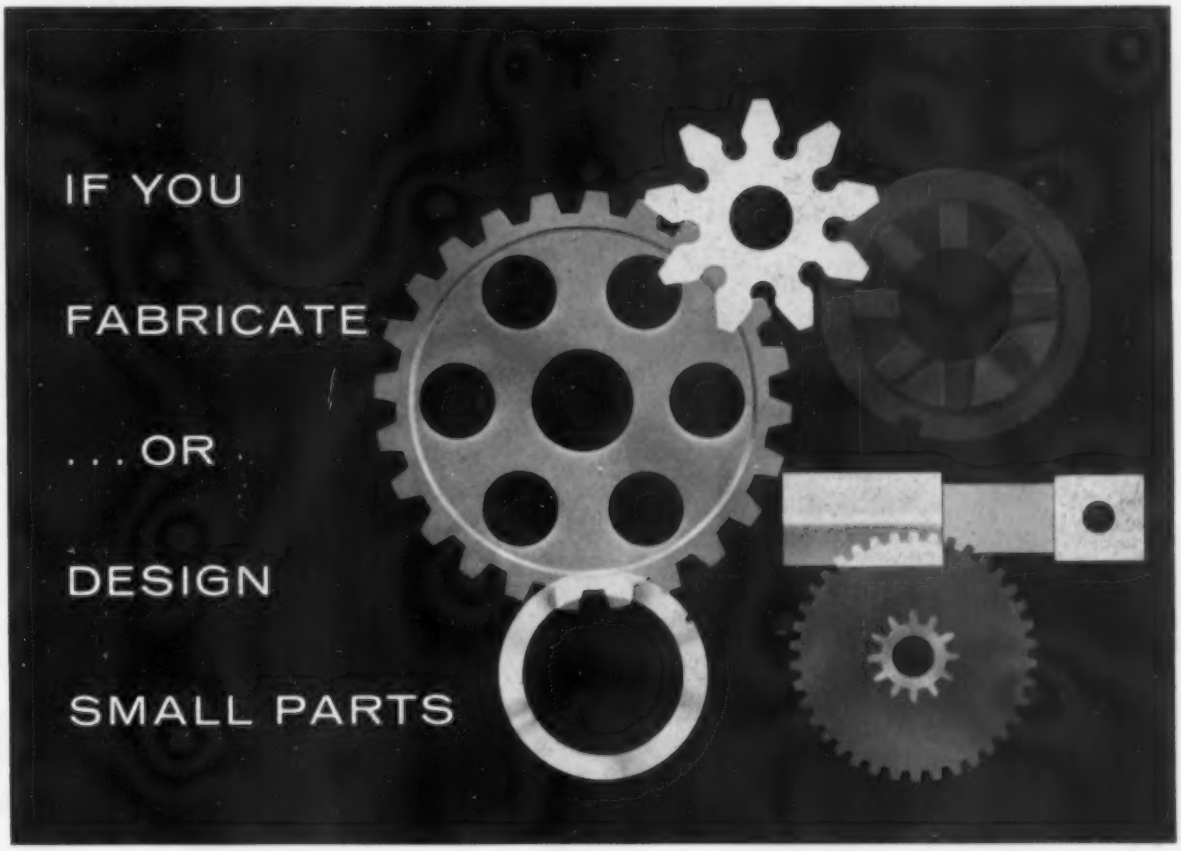

Republic Iron Powder offers you new profit opportunities!

In many cases, you can make parts faster, more uniform and at less cost using Republic Iron Powder. Or, make complicated shapes which are difficult to produce economically by other means.

Republic Metallurgists can help you make the decision—help you determine iron powder's suitability to your parts. Or, they can suggest alternate methods or materials better suited to your particular needs.

Republic Iron Powder has good green and sintered strength to help you hit design targets and to simplify processing and handling. It is uniformly consistent, thanks to the qualities of base material and Republic's preparation processes. Particle size distribution and apparent density are carefully controlled. Republic's hydrogen reduction process has established acceptable limits on flow rate, hydrogen loss and chemical analysis.

Iron powder is coming up fast. According to the Metal Powder Association, approximately 30,000 tons were shipped in 1955—a phenomenal increase over 1954. Check the coupon for more information on using Republic Iron Powder in your parts production.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL

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Please send more information on Republic Iron Powder

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QUICK VISUAL inspection is given to each gate of zinc die castings for apparent defects before being passed along for trimming and finishing. Shown here is the camera housing.

HAND TOUCH-UP of the completely finished Linex camera prepares it for final inspection. The black crackle finish is applied over the phosphate-treated base metal. Little polishing and buffing is required before the coating is applied.

THIS THREE-DIMENSIONAL color camera is a fixed-focus, single speed, two aperture, magazine loading unit for daylight or flash photography. Zinc die castings make up most of its structural components.

HAND FILING of parting lines to remove flash and burrs illustrates the simplicity of processing. The smooth as-cast surface and accurate cast dimensions eliminate the need for elaborate machining or holding fixtures. Principal machining is the tapping of 14 small holes.

Zinc Die Castings Give Weight and Stability To This . . .

Little Camera With Big Features

YOU can slip the new Linex three-dimensional camera into your pocket, and yet it has built-in features equivalent to larger-size equipment.

To accomplish this, Linex Division of Lionel Corp. depends largely upon zinc alloy die castings which make up most of the components, from tiny aperture adjustment parts to the main camera body.

The extra weight of the zinc, company engineers decided, is preferable to the lighter alloys for this unit which, due to its small size, needs the weight for stability and improved handling. The complete camera measures only 6¾ x 2 x 3 inches and weighs 17½ ounces.

Six major parts of the camera are die cast: film advance block, aperture control, camera back-lock, magazine slide bar, front end of camera which serves as lens and shutter mounting, and the main housing.

After casting, flash is trimmed, and the parts are hand filed and deburred. Two small holes in the end of the main housing are drilled; twelve others are cored and tapped. An advantage of zinc base alloy over other metals relates to these 14 tapped holes in

Continued on page 76

High reactivity of titanium has hampered its utilization, but several powder metallurgy techniques have been developed to overcome these handcaps. Here is a report on the methods now being used in . . .

Titanium Powder Metallurgy (Part two)

by R. F. BUNSHAH*, H. MARGOLIN**, and I. B. CADOFF***

THE principal limitation in the consolidation of titanium is its high reactivity at elevated temperatures, particularly in the liquid state where its behavior is such that no crucible material has yet been developed that will contain titanium above its melting point without reacting with it. It was this property which led the early investigators of titanium to use powder metallurgy techniques to produce the necessary solid metal for their work. However, precautions in handling titanium powder consolidation were also required to minimize the contamination of the material during the preparation of suitable powder; the selection of proper powder size, compacting pressures, suitable sintering temperatures and protective atmospheres were dependent upon this reactivity.

Production of Titanium Powder

Of the various methods used for the manufacture of metal powders, one or more of the following are applied to titanium.

1. Mechanical comminution
2. Chemical reduction of metal oxides or salts
3. Electrolytic reduction
4. Hydrogenation
5. Aluminothermic processes

In this country, the reduction of titanium tetrachloride by an alkali or alkali earth metal, such as sodium, calcium or magnesium, is perhaps the most commonly used method for the production of "sponge" titanium, which serves as the base material for powder production. Reduction by magnesium is of course the well-known Kroll process. Sponge is now produced which is quite low in the interstitial contaminants, oxygen and nitrogen. However surface contamination may be introduced during mechanical comminuation to powder, the effect of this contamination increasing as the powder size decreases, due to the accompanying increase in surface-to-volume ratio. The use of extremely fine powders is therefore not advantageous.

Processes other than the Kroll process are still largely in the experimental or developmental stages. Several of these processes produce powder directly. Electrolytic processes developed by United International Research Corporation and Horizons, Inc. fall into this category.

An unusual process developed in Belgium consists of the preparation of an agglomerate of titanium and aluminum containing about 40-65 percent Ti, by aluminothermic reduction of TiO_2. The resulting titanium powder extracted by leaching the alloy with soda contains about 2 to 3 percent Al and 0.3 percent O_2. It is not clear whether the aluminum is dissolved in titanium or mechanically entrapped. However, with proper development, this process may be advantageous inasmuch as aluminum is the principal alloying element for titanium.

The General Electric Company laboratories in England have reported success with a powder process involving the use of titanium hydride. To produce hydride powder, titanium sponge is pretreated to 700 C in a vacuum of 10^{-5} mm of mercury to activate its surface. Next it is cooled to 450 C and exposed to high-purity hydrogen. The sponge is thus converted to hydride which can be crushed readily to a fine powder. Some surface contamination of the hydride occurs during crushing but no further deterioration results from standing in air for times up to one month. The hydride powder ranges in size from 150 to 300 mesh and is quite suitable for alloy preparation. Titanium powder free from hydrogen may be prepared by heating the hydride in vacuum at 800 C until all the hydrogen is evolved.

Consolidation Techniques

Dean, Long, Whartman and Anderson and Dean, Long, Whartman and Hayes in 1946 reported on what was perhaps the first extensive investigation of titanium metal prepared from Kroll process sponge titanium using powder metallurgy techniques. Recognizing the reactivity of titanium they used a coarser powder than is normally used for powder metallurgy processes. Fine powder having a large surface area per unit volume was found to contain more adsorbed gases which reacted with the titanium on heating. Powder having a maximum particle size of

*Associate Engineering Scientist, New York University; **Head, Physical and Structural Metallurgy Section, Metallurgy Laboratory, N.Y.U. ***Assistant Professor, and Head of Solid Technology Group, N.Y.U.

30 mesh with not more than 15-20 percent passing through the 200 mesh was found to be a satisfactory compromise between the requirements of powder metallurgy and the sensitivity of titanium to oxygen.

Titanium powder is soft, presses well and the green compacts may be handled freely. Dean et al. pressed compacts up to 100 tsi but found that above 50 tsi the increase in densification obtained did not compensate for the disadvantages of the higher pressures involved, and used 50 tsi as the optimum value. At this pressure the compression ratio of the powder was about 3½ to 1 and the green compacts reached a density of about 80 percent of theoretical.

Although the powder does not adhere to the die surfaces and does not require the use of die lubricants it was found desirable to moisten the powder with C.P. benzene (about 5 percent by weight) to reduce the tendency towards size segregation on loading and leveling. About 95 percent of the benzene was forced out of the powder on pressing and the rest evaporated rapidly.

Sintering required a vacuum of the order of 10^{-4} mm Hg to remove the adsorbed hydrogen, distill off the residual magnesium in the powder and serve as protection against oxygen and nitrogen contamination. A purified helium atmosphere was found to be unsatisfactory since it prevented the removal of hydrogen and magnesium.

A sintering temperature range of 600 C to 1080 C was explored and the results indicated that for maximum workability sintering should be carried out in the 850-1000 C range. Low temperature sintering resulted in insufficient consolidation whereas sintering above 1000 C was found to result in accelerated oxygen pick-up with accompanying brittleness. Shrinkage on sintering amounted to about 4 percent of the linear dimensions and raised the density to about 95-96 percent of theoretical.

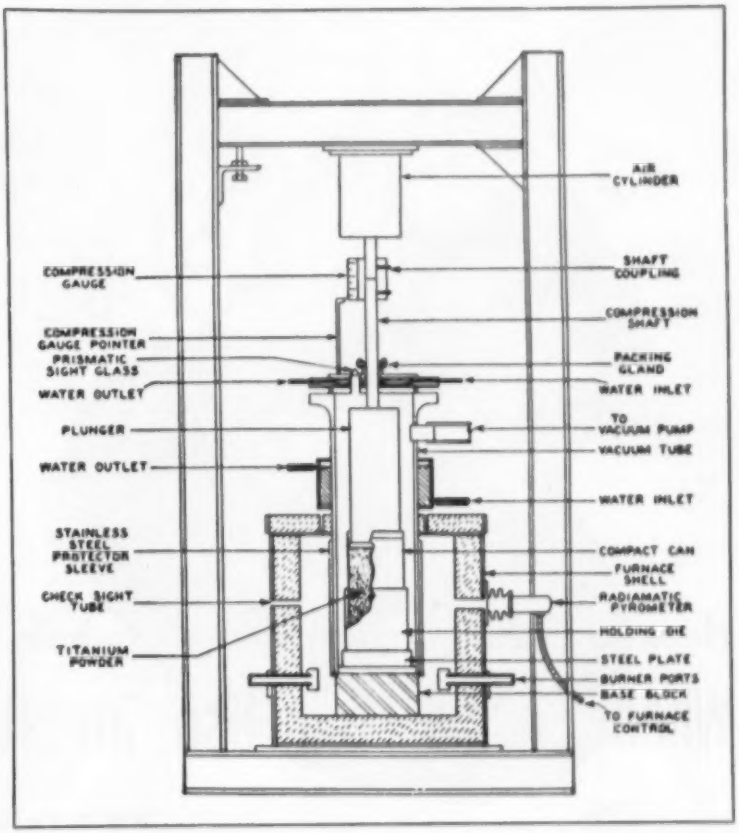
A modification of the powder metallurgy technique for titanium by which the continuous use of a high vacuum was eliminated was proposed by Long in 1948. Called sheath working, the method consisted of sealing titanium powders in welded containers and working powder and container at elevated temperatures. Iron was usually used as the sheath material, the allowable working range being 800-1000 C. The upper limit was imposed by the tendency of thin sections of sheath to oxidize and also by the formation of a low melting Fe-Ti alloy which caused the sheath to burst.

Additional precautions which must be observed include the proper removal of active gas before the sheath is sealed and allowance for some 60-75 percent reduction in volume when the powder is consolidated. The confining action of the sheath brings about particle distortion and rupture of surface films producing good contact for diffusion and welding.

The development of melting techniques for titanium consolidation drew interest away from powder metallurgy techniques, but this interest has recently been revived by the Brush Development Co. division of the Clevite Corporation, who have announced two processes for the production of titanium powder parts.

The first method, called a hot pressing method, is used for the prototype work where small quantities are required. As re-

Continued on page 137



HOT PRESSING METHOD developed by Brush Development Company uses this vacuum sintering furnace. A weighed amount of powder is poured into a graphite mold that has been machined to the proper contour. After mold and plunger are installed in the furnace, it is sealed and evacuated to 1 or 2 microns, the compact is heated to 850-900 C, and hydraulic pressure is applied.

Design Freedom: Greater complexity of shape and wide choice of materials are permitted by the investment casting process. This steel number wheel was formerly produced by brazing the hub, sprocket, wheel, edge ring, center rings, advance cog and end clutch. By redesigning for investment casting, all assembly operations were eliminated and costs were cut in half.

Here are some practical pointers to help answer the question...

When Should You Use Investment Castings?

WM. O. SWEENY, Vice President, Sales
D. M. STAGG, Director of Market Research
Arwood Precision Casting Corp.

MANY times we have been asked to explain the best way to determine when a metal part should be investment cast and when it should not. A simple guide that we have given is:

CONSIDER INVESTMENT CASTING—When the part is of a shape, an alloy, or a quantity that cannot be economically produced by any other means of production.

DO NOT CONSIDER INVESTMENT CASTING—When the part can be produced in the specified alloy, shape and quantity by any of the lower-cost mass production methods.

However, the process should also be considered for parts now being produced by conventional production methods, if they are not meeting performance expectations and requirements. This is a good time for the design engineer to consult with the investment casting engineer on the possibilities of eliminating subassembly work, changing the alloy, or re-designing the part in general for the improved performance needed.

Only when all the design and alloy details are carefully checked at the initial designing or re-designing stages, can the economies investment casting has to offer be fully realized.

While each part presents its own special problem, there are certain general design criteria that will help in designing a new part or re-design an existing part for investment casting. These pointers are depicted in the accompanying illustrations.

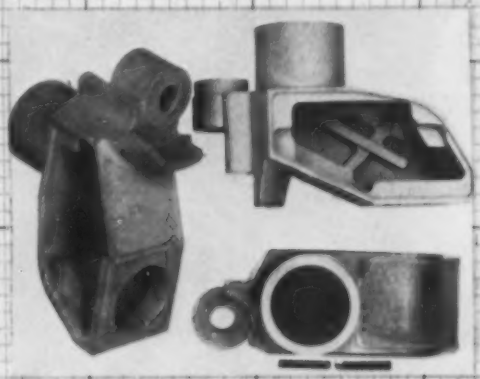
The main thing to keep in mind, whether designing or redesigning a part, is that the best results can only be obtained, and the lowest costs realized, by designing for the advantages inherent in the process, by thoroughly understanding its limitations, and knowing what to do to overcome them.

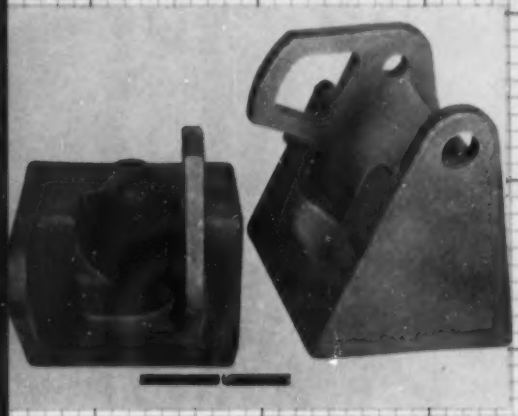
For instance, the stainless steel flange on the facing page is a good example of designing for the process with knowledge of both its advantages and so it was designed primarily for casting to shape. Then the critical dimensions were easily maintained by locating from the cast contours and the holes were drilled and reamed in relation to them. This is a typical example of why the foundry's engineer and the foundry he represents play such an important part.

By working with such a foundry engineer, designers and production men can have half their job done for them when they are considering the use of investment casting.

CASTING DESIGN CRITERIA

UNIFORM SECTIONS—All unnecessary mass should be avoided. All heavy areas which are not required to shield moving parts should be cored out. Frequently the removal of such non-functional surplus lightens the casting and makes it easier to produce. In some cases heavy sections or extended wall areas can be designed to be cored or to be cast with a series of holes. Extreme caution should be used with the latter method lest the strength of the part be lowered.

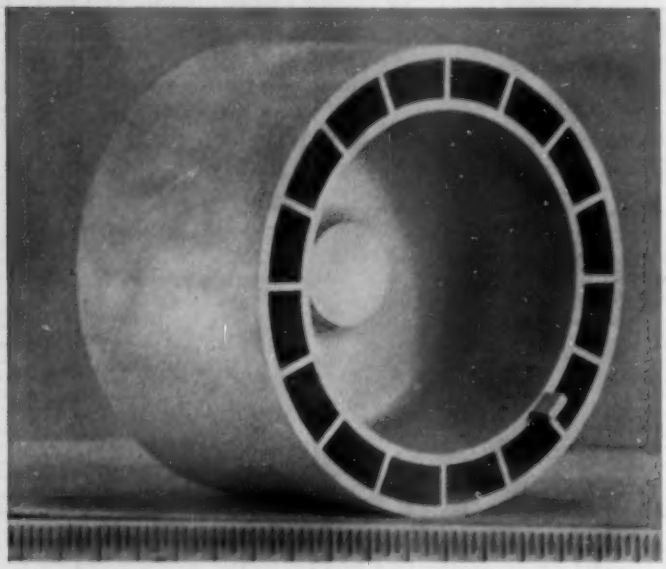




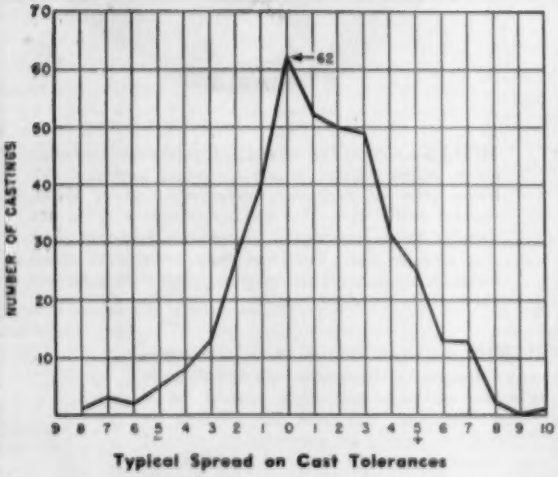
AVOID ISOLATED HEAVY MASS—If heavy sections cannot be cored to make a good casting structure the part should be designed to make it possible to gate them separately. All parts of a casting have to be fed during solidification and the ideal solidification proceeds toward the gates and risers, leaving them the last parts to freeze off. However, an isolated heavy section will feed the surrounding lighter sections, thereby forming cavities within itself, unless it is gated or risered to eliminate the shrink cavity.

HOLES—Since the advent of preformed ceramic cores, holes are no longer a casting problem. All holes over ⅛" diameter, either through or blind, can be easily cast. The smaller diameter holes are usually more economical to machine however they can also be cast. Problems may arise with small holes in thick sections or with holes that intersect each other at right angles.

TRANSITION between thin & thick sections — Where any change in thickness or direction is made between sections, transition should be a gradual one. This can be done by filleting or tapering. The fillets should be generous in order to avoid heat concentration in the mold and stress concentration in the casting, which lead to hot tears and cracks.



WALL THICKNESS— Where ferrous and high temperature alloys, within areas of approximately ½" square are considered, the wall thickness is usually kept to a minimum of .050. Areas over ½" are kept to .090 minimum thickness. However, with the non-ferrous alloys, such as aluminum, magnesium or copper, a substantial area can be run as thin as .030. With the highly fluid metals, sections as thin as .020 are possible.

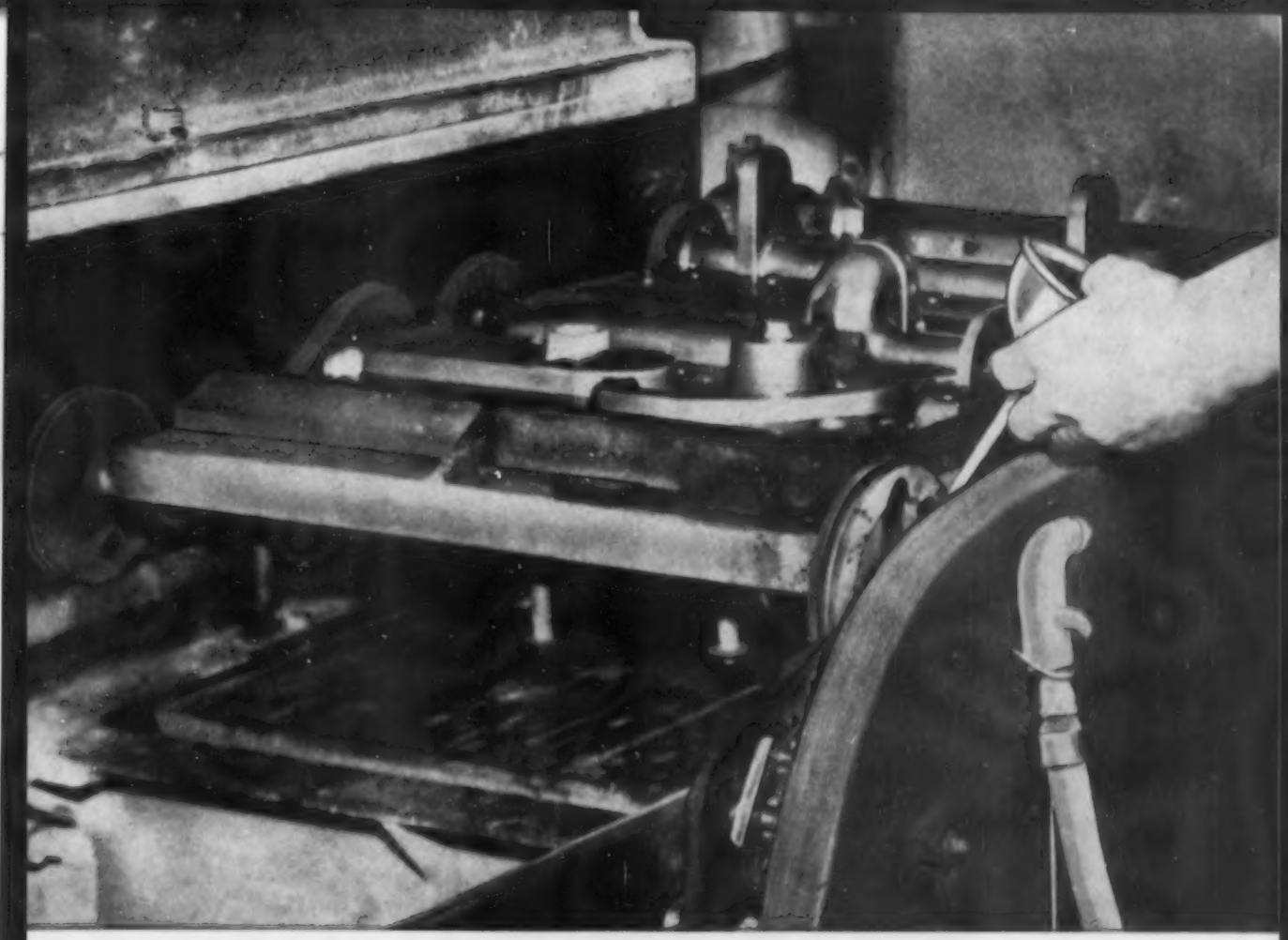


Typical Spread on Cast Tolerances

THREADS & SERRATIONS—Normally it is not good practice to investment cast threads. However, there are some unusual designs or special thread forms that have been cast successfully. It is usually more economical to provide additional stock for machining the threaded area. Serrations are cheaper to investment cast than to machine. Edge and root radii for serrations in the low temperature alloys may be 0.005, whereas in steel they are normally 0.012.

TOLERANCES—For economy, maximum permissible tolerances should be specified. The note "all other tolerances not specified should be ± .003" on blueprints can add tremendously to the cost of the casting. Tolerances of ± .005 per inch should be allowed for critical dimensions, with a minimum tolerance of ± .003 on dimensions of ⅝" or under. On non-critical dimensions, it is best to allow ± .010 per inch.

For more information circle No. 3 on the Reader Service Card



'dag' dispersions . . . *a touch does so much!*

'Oildag' vital to continuous molding-machine operation

Production Pattern & Foundry Company of Chicopee, Mass. runs its five shell-molding machines 24 hours a day to keep up with casting-floor demand for molds. To stand up under this tough service, the machines must be properly maintained.

Maintenance personnel at Production Pattern & Foundry have found that lubrication instructions of the machine's manufacturer have paid off handsomely. Shell Process Co., which makes these shell-molding machines, recommends **'Oildag'** — colloidal graphite in petroleum oil — diluted with five parts of No. 10 oil for the lubrication of critical wear points: the axle bearings of the drive mechanism, and hitch-pivots and link pins of the roller chain. Since the roller chain is subjected to 900° F temperatures within the shell-baking oven, conventional lubricants would be useless . . . would decompose and carbonize. Proof of the effectiveness of colloidal graphite for this heavy-duty high-temperature lubrication job is the fact that the machines have operated without breakdown for more than six years!

Dispersions of colloidal graphite are extremely valuable elsewhere in the foundry too: as long-lasting lubricants for moving parts of casting machines and other foundry mechanisms; as heat-resistant ladle coatings, and effective mold coatings for better parting and controlled cooling. You can learn more about the use of **'dag'** dispersions in metal-casting operations through Acheson's Bulletin 425. Write for your free copy today.

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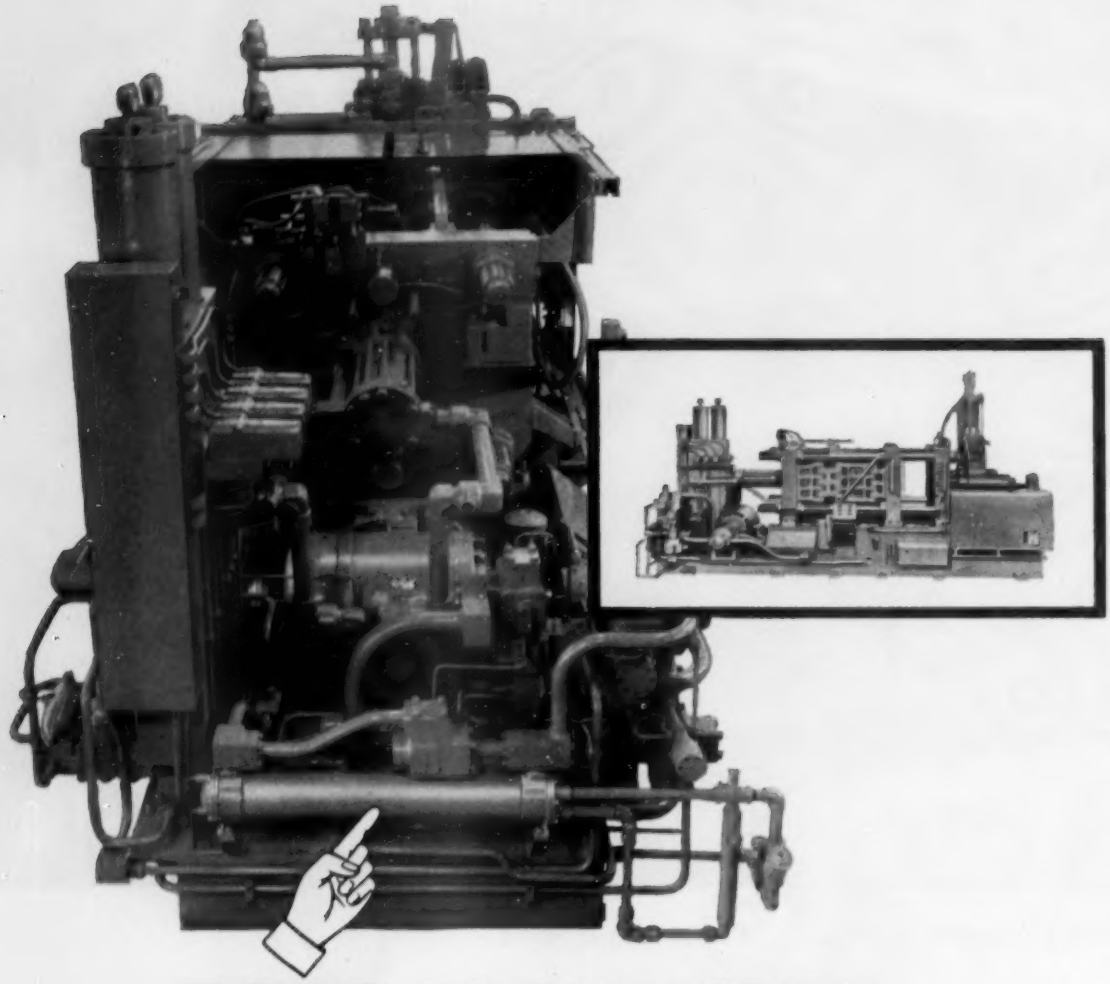

ROSS EXCHANGER

maintains steady oil temperature

in this new, larger Cleveland Die Caster

Strain gauge tested at 500-ton locking pressure, this new Model 500 Cleveland Die Casting Machine has a 25 lb. maximum shot capacity.

Hydraulic oil, supplied by the 200-gallon reservoir, is kept from overheating and thinning by a Ross Type BCF Exchanger. Power losses, caused by fluctuating oil temperatures, are prevented. Peak performance is assured.

Noted for their high thermal efficiency and extreme ruggedness, Ross Exchangers are specified for numerous types of hydraulic machinery: extrusion and metal drawing presses, die casting machines, powdered metal presses, injection and compression molding machines.

Pre-engineered and fully standardized, they're available in a wide range of sizes.

Bulletin 1.1K5 will give you detailed information. Write to Ross Heat Exchanger Division of American-Standard, 1446 West Avenue, Buffalo 13, N. Y. In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

ROSS | ROSS HEAT EXCHANGER PRODUCTS

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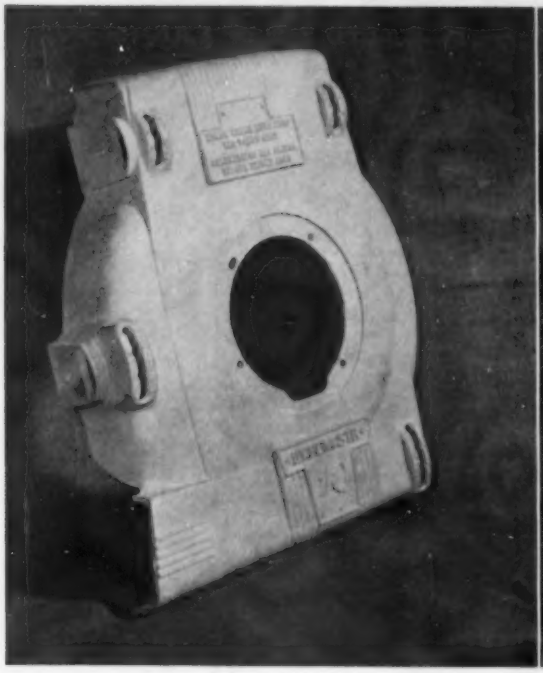
DIE CASTINGS and **PERMANENT MOLD CASTINGS**



PERMANENT MOLD DECK . . .

OR DIE CAST DECK

Largest group of PMM parts to be used in any outdoor tools around the home, go into the construction of . . .

Power Lawn Mowers

POWER MOWERS undoubtedly account for the largest single group of precision metal molded parts found around our yards and gardens. Both the rotary and reel type units have made increasing use of these components. Above are shown two castings being used by Hummer Manufacturing Co., the factory division of Montgomery Ward. The hand pushed power mower uses an aluminum die cast deck (top left) which is not only most economical in the quantities required, but also permits incorporation of a simple, functional wheel adjustment feature. Aluminum Company of America produces this casting from its alloy No. 380. For the 21" self-propelled mower, where production quantities are lower, a permanent mold casting in Alcoa alloy A108 is used. Stahl Specialties make this casting for Hummer.

GARDEN TRACTORS, CULTIVATORS, TREE PRUNERS, CLIPPERS AND TRIMMERS

In the good old summertime . . .

and in winter, too

Tailor-made physical properties are used to meet the varying requirements of components in this versatile year-'round . . .

Garden Tractor Power Unit

By HOWARD OBER, President
The Roto-Hoe & Sprayer Co.

THE ultimate tensile strength yield point, hardness, ductility and other mechanical and physical properties of a powdered metal compact depend, to a great extent, upon the density of the part. It is possible, therefore, to produce parts with almost any desired properties or combination of properties by choosing the proper scheme of fabrication within the frame-work of powder metallurgy.

For ferrous-base materials the probable minimum ultimate tensile strength is somewhere around 12,000 psi and the maximum around 200,000 psi. The lower limit is achieved by either using a part of low density, high porosity, or somewhat higher density but in the fully annealed condition. The upper limit is reached by making parts fully dense of iron powder only or by impregnating a porous skeleton with copper. In either case the final part must be carburized and hardened.

In addition to this wide range of properties that can be secured through the use of powder metallurgy as a fabricating method, there is also a reduction of costs due to the elimination of machining operations. In some cases, there is an added advantage that if lubrication is required and if a somewhat porous part can be used, the oil retaining properties of the cellular structure can be utilized to advantage.

No other method of fabrication of metal parts can give this unique combination of advantageous properties.

Here, at Roto-Hoe & Sprayer Co., a thorough stress-analysis disclosed that a number of parts were over-designed and that the actual stresses set up, even during extreme conditions, were well within the limits of parts made from metal powders and these parts could be more economically made from powders than from wrought stock.

Not only did the over-all economics favor production by powder metallurgical methods, but the study disclosed that the more conventional methods of manufacture were, in some cases, incapable of producing as good a part.

For example, consider the two sprockets shown in Figure 1. Disregarding, for the moment, the question of costs, **powder metallurgy is capable of producing these parts with a more nearly true involute shape on the teeth than can any machining method.** This, of course, results in more nearly true rolling contact between the chain and the teeth with a consequent increase in power transmission due to lower friction losses. Since die surfaces can, for a moderate increase in cost, be made far smoother than can the surfaces of individually cut teeth and since properly made parts from such dies will accurately reflect the surface finish of the die, the sprockets made from metal powders are characteris-

tically *smoother than either cut or hobbed ones.*

This improved surface is immediately reflected in quieter operation and improved efficiency of the transmission train. A further improvement that is secured by the better surface is the reduction, or elimination, of minute grooves and scratches that can act as locii of stress concentrations which may result in tooth failure.

Tool wear is, of course, another factor which must be considered in the over-all economic picture. Particularly with the better grade of steels which must be used for these parts, tool wear is rapid when the more conventional methods of fabrication are used. This results in both high tool maintenance costs and in high rate of rejection of parts due to being off dimensions.

In properly made dies, these same parts can be made of metal powders with a degree of uniformity that can not be achieved by other methods. As a general rule, parts made in properly designed dies are **so uniform at critical dimensions that inspection is reduced to less than two percent of the parts,** the minimum for statistical quality control methods.

Brazing And Sintering At The Same Time

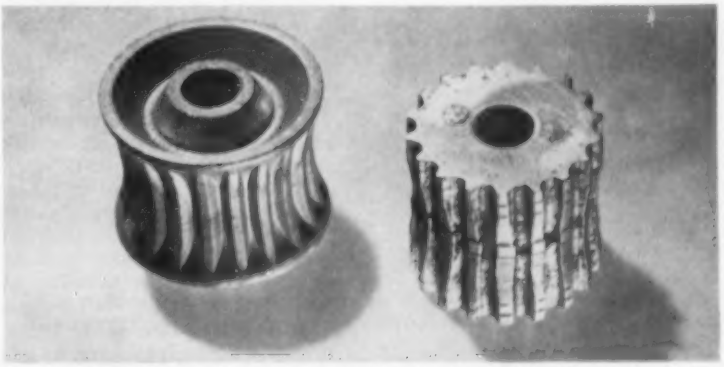
Some of the other economies made possible by powder metallurgical techniques become apparent when the parts are studied. For example, on the one sprocket, two drill rod pins are inserted into cored holes. These pins engage the sliding member of the two speed transmission and transmit the total power from the engine to the wheels of the unit and to operating attachment.

On the grooved member, also shown in Figure 1, the cooperating pins are shown. Service conditions here are severe since power application is always accompanied by impact at the time that a shift is made from neutral to either high or low speed.

When the sprocket and the sliding member are pressed, cored holes are provided and the drill rod parts put in place. Application of phosphor bronze brazing rings then permits brazing and sintering simultaneously. It will be noted that a bronze bead has been added to back up the pins

Continued on page 146

1. DRILL ROD PINS are inserted in cored holes in the green compact, along with phosphor bronze brazing rings, so that brazing can be accomplished at the same time as sintering is done. This saves both drilling and brazing operations.



2. UNDERCUT SIDES of the cog belt pulley are obtained in the powdered iron part, left, by means of a four-segment die. Performance is much better than with the old type pulley built of seven stampings, right.

3. COMBINATION OF STRENGTH and shock resistance are important properties of these support brackets. Note the accurately formed locking teeth easily procured by powder metallurgy.

OUTDOORS . . .

OR INDOORS

COVER STORY

Die cast zinc and aluminum give the uniformity, ruggedness and low cost needed in manufacturing this . . .

Multi-Purpose Power

By **DONALD MOE**
Iron Fireman Mfg. Co.

WHEN the idea of a small, versatile, power-driven garden cultivator was first conceived, we realized that if such a unit were to be built powerful enough to do a good job and sturdy enough to last for many years that it would, of necessity, be rather expensive.

We were further faced with the inescapable fact that over much of the country, and certainly those parts having the greatest density of population, the normal gardening season is less than six months out of the year. To achieve the widest possible acceptance, the new cultivator had to follow the trend of many home power tools; i.e., it had to be so designed that a single power unit could be used for a number of different jobs.

As the Moe-Hoe exists today, it can, in addition to doing its basic job of garden cultivation, be used as a floor scrubber and polisher, a portable drill, a small lawn mower, a power grinder and a small table saw.

However, even with these plural uses, we realized that manufacturing costs had to be kept low or the unit, at consumer level, would be priced out of the market. Obviously the quality of the tool and its attachments could not be sacrificed so that there remained only the possibility of holding down the number of man hours of labor that would go into manufacturing operations. The answer to this need was, of course, the widest possible use of die castings.

Even an experienced user of die castings, however, is prone to ask for the impossible on one hand and to overlook the obvious on the other hand. To avoid both of these pitfalls, we first selected a die casting foundry to work with and then, at every stage in the development, we consulted with the foundry engineers to determine if our objectives could be met, how a design could be modified to make the die casting both easier and less expensive, what additional features could be incorporated and any other factors that would give the desired end result of a better set of tools at the lowest possible cost.

Development work was most expeditiously done by working from sand cast prototypes. How this worked out can best be illustrated by the handle and motor housing castings shown in Figures 1 and 2. In the case of the motor housing casting, we first designed, on the drawing boards, the unit that seemed to be the most desirable from an appearance and functional standpoint. A sand casting was then made from which the desired final part could be machined, Figure 1a It is very apparent that such a machined casting left much to be desired, particularly if it is to be mass produced.

This machined sand casting was then studied by our own engineers and the engineers from Product Engineering Co., the die casting foundry. Where the sand casting had to be machined to give the proper diameter and concentricity as well as positioning steps to hold the field coils of the motor, a die casting would be accurate enough to eliminate all of this machining.

Again, in the sand casting, all mounting holes had to be drilled

Cultivator

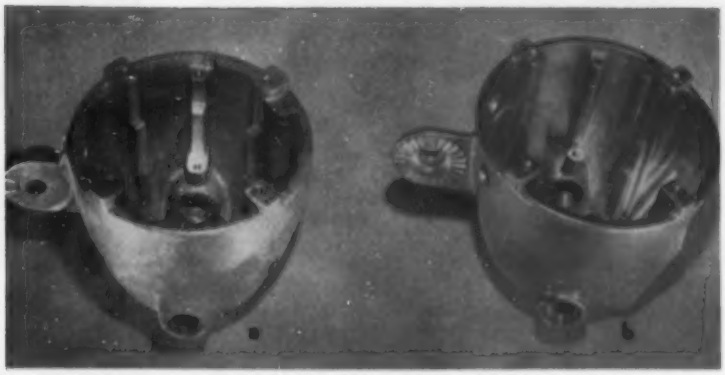
whereas in a die casting they would be cored. Tapping or the insertion of threaded fasteners had to be a second operation in either case. As finally worked out by the die caster, the only machine work other than tapping and drilling a few small holes that had to be done on the inside of the casting was to machine the top bearing seat since the concentricity requirements with respect to the field coil mountings were closer than could be held, even in a die casting.

On the outside of this housing, the die casting process again saved machining and gave a superior product. The cored holes in the brush retainer mountings required boring in the sand casting to assure both proper size and alignment. Both of these requirements are adequately met in the die casting.

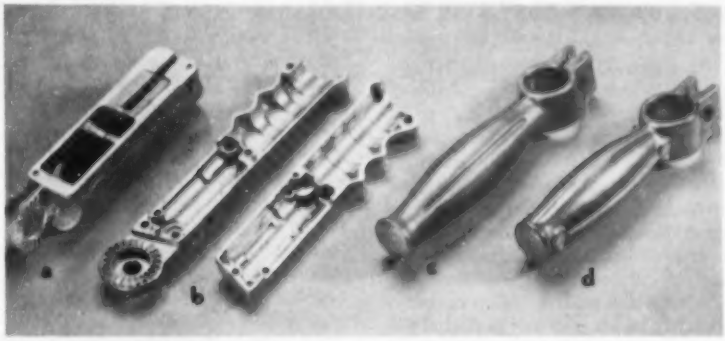
In this same area another difference is found in the amount of metal that had to be cast as a boss. In the sand casting, extra metal must be allowed so that the boss can run out tangent to the housing surface. A projecting boss, such as is possible in the die cast design, is impossible since the pattern could not be removed from the sand. This change gave both a better appearing unit and helped to reduce the weight.

The holes for entry of the cord could not be cored in the sand casting and had to be drilled; in the die cast housing, these holes are cored.

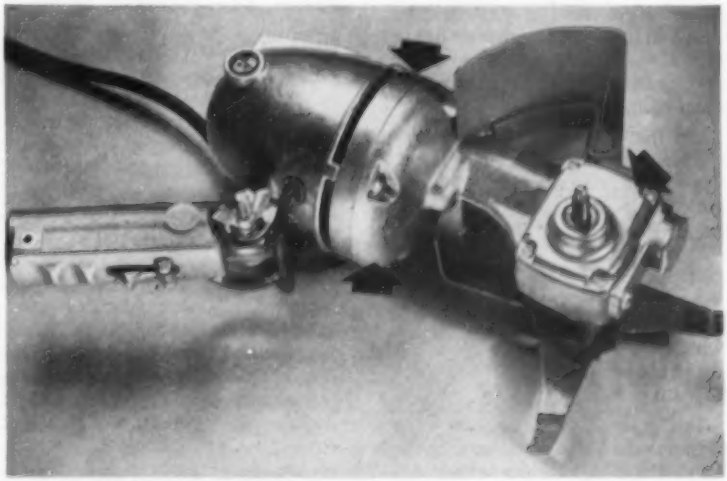
On the lug to which the handle is fastened, we found again that by die casting a lighter weight, better unit could be produced. The sand cast housing held only three locking teeth and these



1. SAND CAST VS DIE CAST motor housing is graphically illustrated here. Multiple machining operations needed on the sand cast housing, left, have been virtually eliminated on the accurate die casting, right. Note the improved mounting flange with a full set of teeth on the die casting, compared to three teeth on the sand casting.



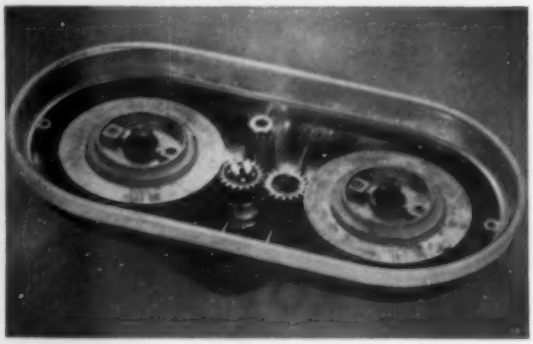
2. COMPLEX CORING needed on the sand cast handle (a) to allow room for electrical wiring, has been avoided on the two-piece die casting (b). Sand cast auxiliary handle (c) is also redesigned now into a two-piece die cast unit (d).



3. MOST EXTERIOR COMPONENTS are die cast. In addition to the motor housing and handles mentioned above, three components indicated by arrows are also die cast in aluminum alloy.

DIE CASTING SIMPLIFIES GEAR DRIVE CONSTRUCTION

Photo: Product Engineering Co.



4. STEEL STUDS are cast as inserts in the die cast zinc polishing head, to serve as shafts for the gears. Center locations are held within required limits, making subsequent assembly simple and dependable. Shown at the left is the die for casting the polisher head, and at the right is a completely assembled head. Note that four of the gears are die cast in zinc, three of them hooded to simplify die construction and trimming.

POWER CULTIVATOR—continued

teeth could not be made sharp and clean without machining. Furthermore, the lug had to be cast flat as shown.

In Figure 1b, the die cast housing is shown and it is quite clear, when compared with the machined sand casting shown in Figure 1a, how the die casting process improved both the functioning and the appearance of the part. Not clearly shown in either of these illustrations is the screened air exhaust for the motor. As sand cast, a cored hole, rectangular in shape, was provided. The perforated metal screen was then shaped and fastened to the housing with either small screws or drive pins. In the die cast version, a raised boss is provided so designed that the screen can be snapped into place and then lightly staked, again a saving in labor and an improvement in appearance.

On the motor unit, three other die castings are now being used. These are a spacing and sealing ring which also carried the lower motor bearing and the gear box cover plate. The same methods and the same lines of reasoning were followed in the design of these two components, both of which are shown in Figure 3. Not shown is the die cast fan for cooling the motor.

In Figure 2, we have shown the original sand cast handles and the final die cast handles which replaced them. The original sand cast handle, which attaches to the motor housing, Figure 2a, had a full ring of cast teeth which engaged the three cast teeth on the mounting lug.

The sand casting process simply was not accurate enough to allow a full 360 degree tooth mating and the cost of machining such teeth would have been prohibitive. Three teeth to lock the handle and motor into position, were considered inadequate. When the different parts were studied for conversion to die casting, it was apparent that this condition could be materially improved.

Another bad feature of the sand cast handle was the complex and expensive core that was required to provide a mounting for the switch. Naturally this part had to be cast as a single piece and this switch box required extensive machining, including considerable milling, a relatively expensive machine operation.

When the problem was discussed with the foundry engineers, they suggested a two piece handle as shown in Figure 4b. With this design, practically all machining operations, except tapping, have been eliminated.

The auxiliary handle also shown in Figure 2c and d again represented a major manufacturing improvement when the fabricating method was changed. The original sand casting was a one piece part that required boring, drilling and sometimes slotting. Redesigned, it is made as two duplicate parts pinned and riveted together. No machining at all is required either for assembly or mounting.

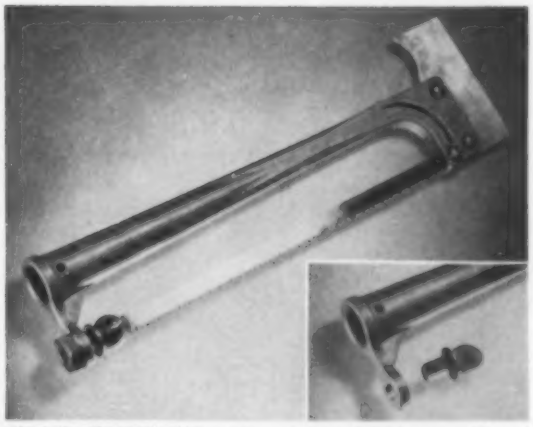
In this part, one small but very important advantage of die casting is noted. A hexagonal recess can be cast in that just fits the machine screw nut used for clamping, the screw head, of course, will then easily fit into the same size recess. This allows the use of a slightly shorter machine screw, eliminates the possibility of scraping the skin or catching clothing on the projecting screw or nut and more importantly allows the handle to be loosened and tightened with only a screw driver rather than a screw driver and wrench.

Since this is a multi-purpose tool, it must be usable with either a long or short handle. We felt that for the safest operation, a trigger type switch should be used that would open the circuit as soon as pressure on the trigger is released. Such a switch was designed and installed in the handle fastened to the motor; it, incidentally, uses a die cast trigger.

All of the aluminum castings used on this tool are simply and easily finished by barrel polishing. Vestigial flash, burs, etc. are removed in this operation and the entire surface given a pleasing appearance.

Of the several zinc die castings used, only the polisher housing needs to be surface finished. The as-cast zinc surface is always sufficiently smooth and free of defects so that prior to cleaning and painting only the slight residual flash and any burs have to be removed.

DIE CASTINGS



BEST PERFORMANCE at lowest cost has been achieved by the two die cast components of this tree pruning tool which is mounted on the end of a pole.

In gadget that is held above the head, die cast aluminum gives a better ratio of strength-to-weight than sand cast iron for this . . .

"Do-It-Yourself" Tree Pruner

THE man who trims trees and bushes for a living buys expensive tools at the start and takes care of them, since his livelihood depends on his tools and he cannot afford to be continually replacing them because of his own carelessness.

For the "do it yourself", weekend gardener, however, professional grade tools are too expensive. Not only is the first cost high, but the amateur is notorious for careless handling and maintenance of his tools.

In designing a pruning tool specifically for the home handyman, Glendale Industries, Inc. of Toledo, Ohio, had to consider these differences. Further, if such a tool is to have a wide sale, it must be low in first cost and easy to handle. The pruner as finalized is shown above, the complete tool and the cast components.

The first concept, at the start of design, was for a frame member as a malleable iron sand casting. The supposed advantages of this method of fabrication were low tooling costs, low per piece costs and reasonably easy machining. With the exception of the lower tooling costs, all of these early assumptions were in error.

The one factor that immediately discouraged the use of a malleable iron sand casting was weight. To achieve the required rigidity, the frame had to be so heavy that it became unwieldy when mounted on the end of a five to ten foot long pole. The design was then changed to a sand cast aluminum frame. Here costs entered the picture more strongly and, in the final analysis, it became far more economical to make the frame as a die cast aluminum member. The design, as finalized, was the result of close co-operation between the company and the foundry, Litemetal Dicast, Inc. and represents the lowest cost, lightest weight frame that can be made to stand the anticipated service conditions.

As a base for design, there are several features that must be considered and others which it is desirable to consider. Strength and lowest possible weight are, of course, paramount. Resistance to impact is important and corrosion resistance highly desirable. From the manufacturer's point of view, it was most desirable that as few operations as possible be done on the castings so that when they are received from the foundry only an assembly operation needs to be done. Costs, of course, had to be kept down.

Considering strength alone, cast iron, brass, bronze, aluminum, magnesium and a few other materials would, of course, be adequate. When weight is added as a factor, either aluminum or magnesium provided the best strength-to-weight ratio and of the two, aluminum was less costly. The problem developed, therefore, into a question of the method of fabrication.

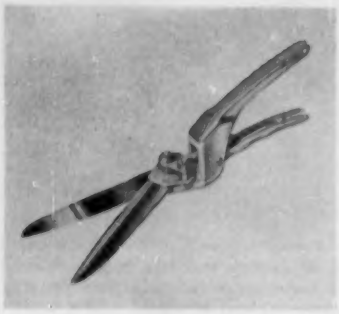
The name plate was easily incorporated into the casting die so that clear sharp lettering was cast on, whereas with a sand casting, such lettering was not readable and a decal, separate plate, or some similar makeshift would have had to be employed.

A further saving is in storage and inventory. As die cast, the frames are ready for assembly as delivered, while the sand castings, rough, semi-finished and finished castings would have to be stocked. Again this saving is not reflected in any of the figures listed.

As a conservative estimate, the die cast frame for this pruning saw costs less than half the cost of a comparable frame if sand cast in aluminum and less than one-third the cost if cast in malleable iron.

DIE CASTINGS

Grass Shears



IN designing a new grass shear the Lewis Engineering & Mfg. Co. was confronted with known factors needed in design. These included structural strength, lightness in weight, eye appeal, handling comfort and an enduring surface finish. Aluminum base die castings proved to be the only economical material and fabricating method that would meet all of these requirements adequately.

Because aluminum weighs only about one-third as much as steel, a thin-wall die casting can be formed that is ribbed to supply equal, if not greater, resistance to deflection and distortion than a similar section made of steel.

Aluminum is one of the very few metals that can be die cast into designs that are economically prohibitive in plain or alloy steels and has far greater strength for a given section thickness than any of the plastics.

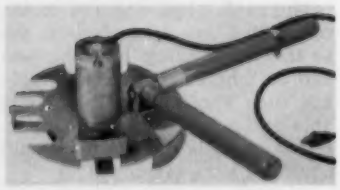
Corrosion protection of any sort is unnecessary with aluminum in this service, and surface finishing can be easily and economically done on the castings used for this shear by barrel polishing and finishing methods.

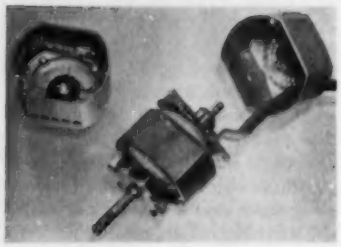
The three castings that are currently used for the Doo-Klip Grass Shear are shown at the left. All of these castings are made by the Die Casting Division of The Hoover Co., and are complete and ready for surface finishing and assembly as they are delivered by the fabricator.

The pebble finish on the top surface of the upper handle serves to prevent the tool slipping in the hand and this finish is incorporated in the die so that it can be achieved at no extra cost. In a similar manner, the finger grips in the lower handle can only be secured in a part of this sort by a casting method and only die casting can produce the casting so that no machine work has to be done.

DIE CASTINGS

Hedge Trimmer





TO design a trimmer that could be used for lawns around bushes and flower beds and next to walks, for edging along walks and also for trimming individual bushes and hedges required a small, light weight unit. The trimmer also had to be easily maneuvered when used at the end of a five foot handle and could also be used with short handles when hand-held.

To do the required job, a unit of the same type as the now popular rotary lawn mower seemed indicated. However, the blade speed had to be very high to give a smooth cut and the torque at high speeds had to be considerable if fairly heavy branches are to be cut.

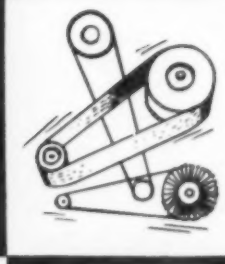
These considerations indicated a small diameter, light weight, high speed electric motor capable of developing greater power than is generally associated with motors of its physical size.

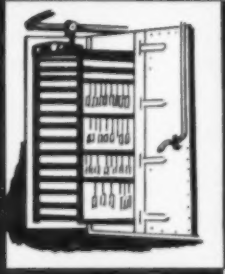
As finally developed, the unit shown in Figure 2 was designed. While the overall dimensions of this motor are only 2¾" diameter and 3½" high, it develops a full ⅛ HP at 17,000 RPM.

To secure both the speed and power required a series wound motor was designed with a much longer field than is normally found in small motors. This increase in both iron and copper gave the characteristics desired.

A problem that faced the motor designer was that of a housing.

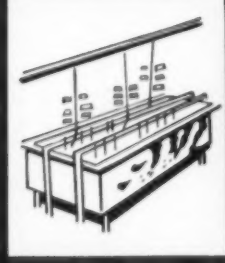
Continued on page 137





PMM

Finishing Section



Finishing includes all secondary operations performed on precision metal molded parts — up to and including final surface treatment. This section presents new information about the specialized methods, equipment and materials needed for finish-machining, assembly, surface preparation and final finishing of all precision metal molded parts.

DIE CASTINGS • INVESTMENT CASTINGS • PERMANENT MOLD CASTINGS • PLASTER MOLD CASTINGS • POWDER METAL PARTS • SHELL MOLD CASTINGS

devoted to the specialized problems of finishing . . .

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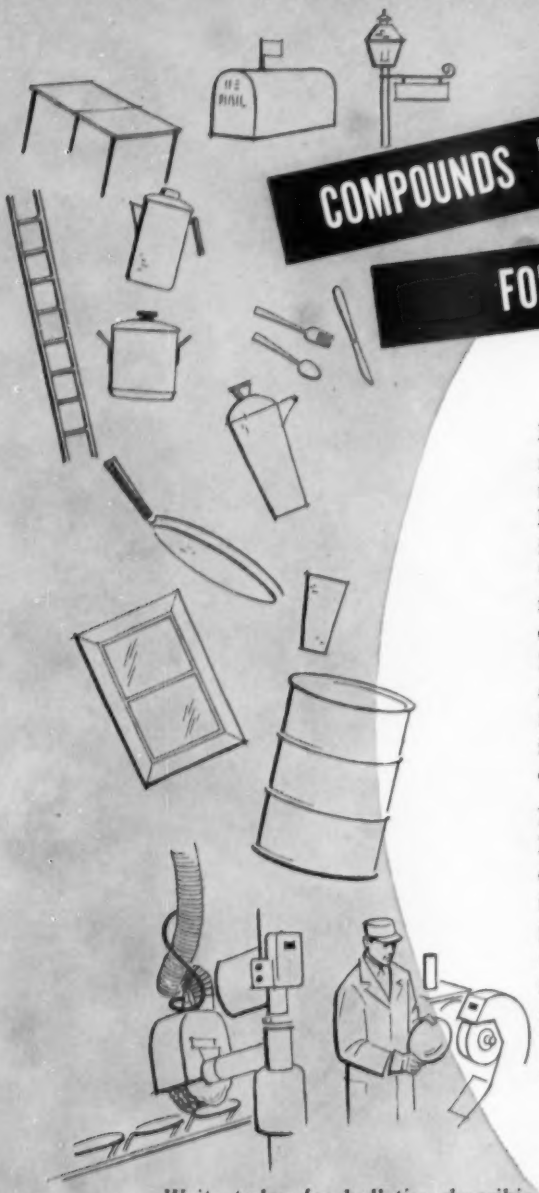

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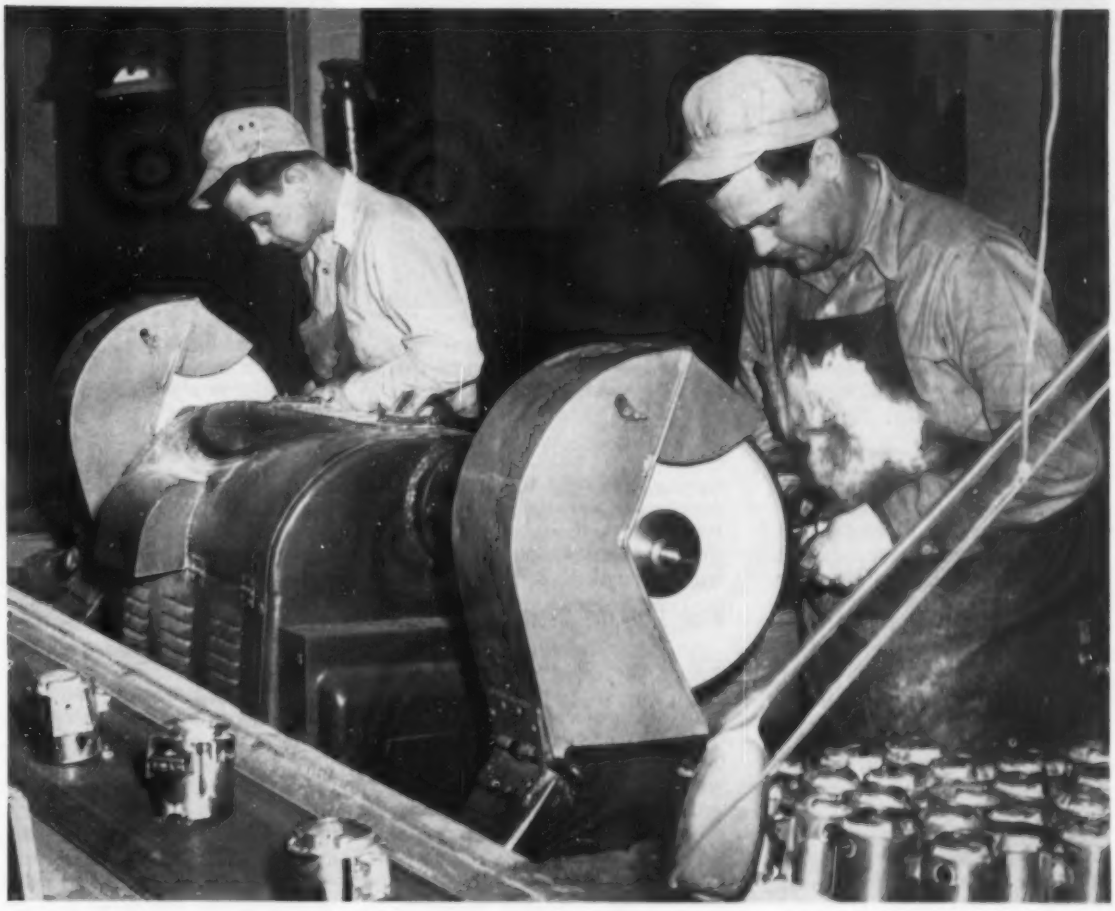


Some Pointers For Efficient and Economical

Polishing And Buffing Of Die Castings

OF the three basic ingredients . . . materials, labor and burden . . . that compose the finished piece cost of metal products, the most expensive is generally labor, the manual effort applied to form, process, finish and assemble raw materials.

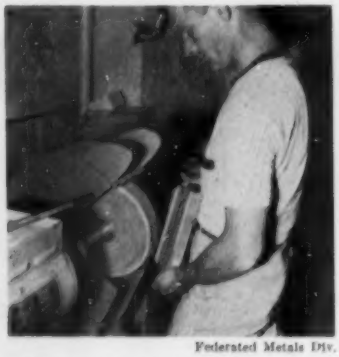
In die cast components, the element of labor for forming has been cut almost to an irreducible minimum; their advantage is the creation of large numbers of complex pieces with a minimum of hand work. This advantage in labor-saving may be lost, however, as the casting moves down the finishing line, unless the polishing and buffing operations have been carefully engineeered.

Designing For Polishing
Equipments And Materials
Recommended Cycles

MANUAL POLISHING AND BUFFING METHODS ALLOW FINISHING OF A WIDE RANGE OF SIZES,

Eastman Kodak

OFFHAND POLISHING of most exterior surfaces prepares these die cast camera housings for painting.



Federated Metals Div.

NESTING 30 zinc die castings in a special hand-held fixture simplifies polishing one surface.

Carborundum

BELT POLISHING gives a uniform surface on this circular, perforated grille prior to plating.

Actual responsibility for economical finishing starts with the product designer. Polishing and buffing must be visualized at an early stage of design: often minor changes in detail can extend the life of buffs, improve the finish achieved, reduce the consumption of buffing compound, simplify the removal of compounds, and generally expedite finishing.

When the casting reaches the finishing department, the process cycle must be planned with proper consideration for several factors: the finish desired, size and shape of the castings, quantity to be finished, type of equipment on hand or the advisability of installing new units, subsequent operations, and, of course, cost.

Outlined here are some pointers on economical polishing and buffing, starting with hints on designing, outlining the types and purposes of various production machinery, commenting on materials and equipment, and charting some typical finishing setups.

What Can The Designer Do?

As J. A. Badaluco of Hanson-Van Winkle-Munning points out, "The designer actually controls the cost per piece of polishing and buffing supplies and labor, as determined by how well the casting will lend itself to the standard 14" or 16" diameter buff. It is most common today to compel or force a standard 8" radius buff into a 4" or smaller radius and necessarily sluff or tear the buff to pieces, thus obtaining only about 20 percent of the actual buff life possible."

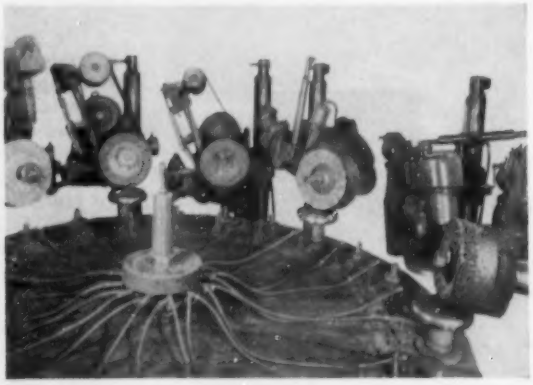
Furthermore, the need for using intense pressure to force a standard buff into a small recess requires proportionately higher consumption of buffing compound to introduce proper lubrication and minimize fire hazard.

This is one example of the effect of contour design upon economical polishing and buffing, but it is sufficient to show that the designer can profit by becoming familiar with actual finishing operations and materials. Sometimes, the contour of a piece is rigidly fixed by functional requirements, but often exterior housing components only provide a loose-fitting "envelope" whose shape and contours can readily be adjusted to economize on finishing. The better the designer understands the conditions which favor low cost polishing and buffing, the more effective will be his designs. Consultation with the

AUTOMATIC SYSTEMS ARE SUITED FOR RAPID, UNIFORM HIGH-PRODUCTION FINISHING OF

Acme Manufacturing Co.

FOR POLISHING permanent mold aluminum pressure cooker covers, this combination 10' 12-station index or 24-spindle continuous rotary unit is used. Parts are held by vacuum chucking and are finished at a rate of 250/400 per hour, depending upon type and size casting.



CLOSEUP of setup at left shows how parts are indexed through a series of belt heads with oscillation on the column and others oscillating on the spindle, using belt arm attachments with air tracking arrangements, before passing buffing heads for final buffing and coloring.

Behr-Manning

FREE AREA of coated abrasive belt is used to strap and polish tight contours of this casting.

GETTING INSIDE of die cast horn ring requires a narrow abrasive belt and special small diameter idler.

Engelberg Huller

FOLLOWING A CURVED surface with an abrasive belt and contact wheel is simple and rapid.

finisher at an early stage of design will also pay off.

What are some of the specific considerations for a designer to take into account? Here are a few:

• Study the number of surfaces to be polished and the number of belt and wheel operations that will be required. You may be able to combine or eliminate some.

• Intermittent surfaces, or those broken by cored holes and recesses, can cause trouble. Excessive wear on buffs can result. Also, you will find it difficult to hold the leading and trailing edges of holes perfectly level and sharp.

• Grille surfaces, or other such detail, can trap and hold buffing compounds, defying ordinary automatic cleaning methods.

• One of the most difficult surfaces to cast and finish satisfactorily is the perfectly flat, plain area. Every minor deviation is magnified. Where possible, some ornamentation such as shallow ribs, pebble-effect or other treatment that is easy to machine into the die cavity can be introduced. Crowned surfaces are generally desirable.

• Direction of polishing is another consideration. Where adjacent surfaces are such that polishing must be done in different directions, it is sometimes difficult to achieve the same appearance on both.

• Shape of the castings and direction of polishing will also affect the design of holding fixtures where polishing and buffing are to be done on an automatic setup.

• It is a common practice today to introduce a belt operation first to remove parting line roots prior to wheel finishing. If the parting line can be planned to lie on non-critical surfaces, the sanding and blending operations can be minimized and difficulties due to porosity at the parting line can be avoided.

• The placing of raised or recessed trademarks, emblems or other identifying and decorative treatments should be most carefully considered in relationship to the areas to be polished.

• Generous fillets and large radii should be allowed wherever possible, and sharp edges or corners avoided.

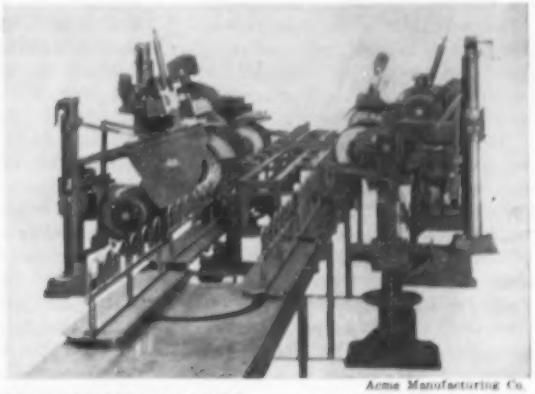
Equipment and Materials Available

The finishing room now has a much wider range of materials

Continued next page

Hammond Machinery Builders

ROTARY HEAD AND STAND unit for buffing die cast or brass plumbing goods combines a 62" diameter table with six adjustable wheel heads that can be mounted at any angle. Feature of this setup is reported to be the variable spindle speeds and variable dwell time.



Acme Manufacturing Co.

DIE CAST DRAWER PULLS traverse down one side of this horizontal return type straight line machine, getting flash polished off and then pass through two wide buffing wheels. On the return trip, opposite side of the handles are polished and buffed. Rate: 1000/1500 per hour.

YOU CAN USE THESE RECOMMENDATIONS AS A STARTING POINT IN PLANNING YOUR POLISHING

	*	BELT POLISHING				SET-UP WHEEL POLISHING					
		Belt	Grit	Speed	Feed	Wheel	Diam	Grit	Speed	Feed	
SURFACES MAINLY FLAT OR GENTLY MODULATED	Z	X-Weight	220 Al_2O_3	6500 sfm	25 fpm	Med Hard 40 Dur.	14"	220	6500 sfm	25 fpm	
	A	X-Weight	150 Al_2O_3 or 220 SiC	6500 sfm	25 fpm	—	—	—	—	—	
SURFACES SHARPLY CURVED OR IRREGULAR	Z	Flexible	220 Al_2O_3	6500 sfm	25 fpm	Sewed Cloth Med Hard	12-14"	220	5000 sfm	As Req'd	
	A	Flexible	220 SiC	6500 sfm	25 fpm	—	—	—	—	—	
SURFACES HAVING LETTERING OR OTHER DETAIL	Z	X-Weight	220 Al_2O_3	6500 sfm	As Req'd	—	—	—	—	—	
	A	X-Weight	220 SiC	6500 sfm	As Req'd	—	—	—	—	—	

* Z — Zinc; A — Aluminum

Polishing And Buffing—continued

and machinery at its command and can tailor the setup specifically for the requirements of any job. Quantities in which die castings are run often makes possible the use of special straight-line or rotary automatics that do the most uniform job at low cost. The per-piece savings can often amortize the cost of the equipment over relatively short periods of time.

Yet some shapes do not adapt themselves to automatic finishing or can only be partially finished on automatics. For this reason, there are few, if any, polishing lines for die castings that do not include lathe and belt setups for manual finishing.

Belt Polishing has come to be an important method of preparing die castings for buffing and coloring, due to the long life and uniformity of abrasive belts available commercially today. The old fashioned set-up wheel, requiring extremely high levels of skill to prepare, maintain and operate, has lost ground to the coated abrasive belt which is available in many lengths, widths, grain types and grain sizes. Also, there are belts suitable for either wet or dry polishing, as needed. Replacement is fast and simple, loading of the belt is minimized, and uniform results are easier to obtain.

Types of machinery commonly in use with abrasive belts must be headed by the backstand idler used in conjunction with a contact wheel. The belt runs over the contact wheel where the work is brought against the abrasive surface, and then tracks around a backstand idler. This allows the surface to cool, and also presents a greater area of cutting surface to the workpiece.

Many types of contact wheels are now in use, depending upon individual requirements. Oldest practice is to use a firm cotton buff or felt wheel which provides a degree of resilience so that the belt can conform to the contour of the workpiece. However, more recently, serrated rubber wheels of specified durometer, and pneumatic tires which can be inflated or deflated to permit close contact against the work surface, have been introduced. Formed felt wheels cut to match the desired contour are also used.

Abrasive tapes, backed by bristles, are another form of polishing tool for use on die castings, as are the split pulleys which accommodate strip abrasive. These usually have a rubber facing to give proper resiliency.

Special designs of machinery have been worked out to permit polishing into narrow concavities, inside of openings such as the interior surfaces of horn rings, and flat platen machines for precision grinding of surfaces are also available. (For a detailed report of these, see "Get The Most Out Of Your Abrasive Belts" by L. H. Vorce, PMM, July 1955, pg. 51.)

Wheel Polishing and Buffing with cotton buffs and the application of either solid or liquid lubricants is very popular, because this type of installation, calling for relatively simple floor or bench lathes, is adaptable to most shapes and sizes of die castings.

Manually done, wheel polishing is accomplished as the operator presents successive surfaces to the wheel, saving the cost of elaborate machinery and fixtures. It can be used for many different castings without any alteration, and is likely to be used for hitting one or more surfaces that

BUFFING					COLORING				
Buff	Diam	Compound	Speed	Feed	Buff	Diam	Compound	Speed	Feed
Bias	12-14-16"	Tripoli	2200-2800 rpm 6500 sfm	As Req'd	Lt duty Bias, Full disc Loose or Sewed	10-12-14"	Silica or Cut/Color Lime	2400 rpm 6500 sfm	As Req'd
Bias	14"	Liquid Tripoli	2200-2800 rpm 6500 sfm	As Req'd	Bias	10-14"	Calcined Alumina	2400 rpm 6500 sfm	As Req'd
Bias Spiral Sewed	14-16"	Tripoli	2400 rpm 5500 sfm	As Req'd	Full disc Loose or Bias	12-14"	Silica or Cut/Color Lime	2200 rpm 4500 sfm	As Req'd
Bias	14"	Liquid Tripoli	2400 rpm 5500-6500 sfm	As Req'd	Bias	14"	Cut/Color Unfused Al_2O_3 or Silica	2200 rpm 4500 sfm	As Req'd
Cooled	12"	Tripoli	2400 rpm	Lt	Cooled	10"	Silica	2000 rpm	Fast
Cooled	12"	Silica	2400 rpm	Lt	Cooled	10"	Silica	2000 rpm	Fast

** Data compiled here includes data from: Hanson-Van Winkle-Munning Co., Maplewood Companies, Roberts Rouge Co., Frederic B. Stevens, Inc.*

cannot be reached automatically, even when fully automatic lines are installed. In some places, the entire finishing line may consist of dozens of polishing lathes, with work progressing from one to the other as each operator brings the work one step farther along.

But die castings are essentially large volume items, used to house home appliances, portable tools, business machines and other high quantity products. They are also principally used for trim on automobiles. In these instances, it is usually most economical to install a completely automatic or a semi-automatic line. The workpieces are then clamped into specially-designed holding fixtures and progress from one polishing head to the next, being turned automatically to present the proper surface to the wheel.

Along with the development of automatic polishing and buffing machinery, auxiliary types of equipment have been developed, such as the automatic spray lubricant.

According to an engineer at Fredric B. Stevens, Inc., the use of liquid buffing compounds has certain advantages, which he enumerates as: 1) No compound "nubbins" to remelt or discard, eliminating waste, 2) Application can be completely automatic or by means of foot control, applying the exact amount within a fraction of a gram, 3) Down time is reduced, and 4) Buff life can be extended by keeping the buff uniformly "headed".

Automatic polishing and buffing machines are keyed to high production rates, and a continuous rotary built to finish the top, shank and underside of knobs at a rate of 2,000 to 3,000 per hour or another to polish permanent mold cast covers for pressure cookers at a rate of 250 to 400 per hour, are examples.

Coloring can be done as a separate, final step in the buffing cycle, depending upon the degree of finish needed, but as R. L. Onkey of Roberts Rouge Company points out, coloring and buffing of aluminum die castings can often be done as a single operation. Compounds and equipment available nowadays sometimes permit the production of a high finish within shorter time cycles due to faster cutting and more closely controlled abrasive materials.

Several manufacturers of equipment for polishing and buffing have been asked to recommend cycles for finishing die castings in zinc and aluminum, having surfaces that are: a) principally flat or gently modulated, b) sharply curved and irregular, and c) having lettering or other detail. Their recommendations have been compiled in the table, above. While there are many variations in suggested treatments, they agree on the principal points. It is apparent, however, that each job must be individually engineered, that general recommendations can only be applied in an individual case with proper reservations and allowances.

Frederic B. Stevens, Inc., has available, for instance, a tabulation of polishing and buffing cycles for eleven different die castings, showing the type of operation, buffs (or wheels) used, type of composition and RPM.

For example, automotive door handles go through two-stage finishing, starting with polishing for flash removal on a 12" diameter contact wheel at 1750 RPM and

Continued on page 65

(Advertisement)

SPECIAL REPORTS ON FINISHING NON-FERROUS METALS

NUMBER III—Lustrous, Corrosion-Resistant Finishing with Chemical Polishing Iridite

WHAT IS IRIDITE®

Briefly, Iridite is the tradename for a specialized line of chromate conversion finishes. They are generally applied by dip, some by brush or spray, at or near room temperature, with automatic equipment or manual finishing facilities. During application, a chemical reaction occurs that produces a thin (.00002" max.) gel-like, complex chromate film of a non-porous nature on the surface of the metal. This film is an integral part of the metal itself, thus cannot flake, chip or peel. No special equipment, exhaust systems or specially trained personnel are required.

Chromate conversion coatings are widely accepted throughout industry as an economical means of providing corrosion protection, a good base for paint and decorative finishes for non-ferrous metals. Certain of these coatings also possess chemical polishing abilities that have luster-producing, as well as corrosion-inhibiting, effects on zinc and cadmium plate, zinc die castings and copper alloys. However, continued developments in this field have been so rapid that many manufacturers may not be completely aware of the breadth of application of this type of finish. Hence, this discussion of the many ways in which this chemical polishing characteristic can be used in final finishing or pre-plating treatments to produce a lustrous appearance with distinct display and sales appeal and appreciable savings in cost. Report I on decorative, corrosion-resistant finishes and Report II on paint base corrosion-resistant finishes are available on request.

The degree of luster possible on a surface is a function of the degree to which the surface can be smoothed. Leveling to provide a smooth surface can be achieved by mechanical or chemical means, or a combination of these, depending upon the luster desired and the original condition of the metal. Chemical polishing effectively imparts luster otherwise difficult and costly to obtain. For this reason, it is often used to supplement or entirely replace mechanical polishing, depending upon the application and the original condition of the metal. Chemical polishing has the additional advantage of providing overall treatment of the submerged part. It reaches into even the deepest corners and recesses that are otherwise inaccessible. Certain of the Iridites are specifically designed to perform this chemical polishing operation. Also, they provide corrosion protection as do all Iridites, thus may be used as a final finish or a pre-plating polish.

If Iridite is to be used as a final finish, in contrast to pre-plating treatment, the chromate conversion coating generated is allowed to remain, providing good corrosion resistance. Color inherent in these Iridite films ranges from a yellow cast to yellow iridescent. These coatings may be used without further treatment where this color is acceptable and good corrosion resistance is desired. Further, these basic coatings can be tinted by dyeing. Among the dye tints available are shades of red, yellow, blue and green. If desirable, the basic coatings can also be modified by a bleach dip leaving a clear bright or blue iridescent finish. In all cases bleaching reduces corrosion resistance.

As examples of this type of final finishing, Iridites #4-73 and #4-75 (Cast-Zinc-Brite) make possible for the first time, lustrous chemical polishing of the as-cast surface of zinc die castings. Thus, in many cases, sizeable savings in finishing cost are realized by elimination of plating costs. This economical method can be used on tools, appliance parts, toy pistols, locks and many other small castings. Another example is the treatment of copper and brass parts, such as welding tips, to eliminate buffing and provide additional corrosion resistance. In many cases, handling costs are reduced appreciably by replacing piece-part handling with bulk processing. Still another example of the use of this chemical polishing and protective quality of Iridite is a simple system of zinc plate, Iridite and clear lacquer instead of more costly electroplated finishes. Typical of this type of lustrous finish are builders hardware and wire goods.

As a pre-plating treatment, in contrast to final finishes, Iridite can be used to chemically polish zinc die castings or copper prior to plating. In such cases, Iridite should be applied as an in-process step, so that the protective film is removed before the plating cycle. The savings in handling, material and labor costs are obvious. This process has made it practical to plate chrome directly over copper on steel, conserving nickel, yet producing a lustrous chrome finish. Used after stripping faulty plate in reprocessing zinc die castings, Iridite restores luster to the casting, thus making possible replating without blistering.

Other Iridite finishes are available to produce maximum corrosion resistance, a wide variety of decorative finishes and excellent bases for paint on all commercial forms of the more commonly used non-ferrous metals. As a final finish, appearance ranges from clear bright to olive drab and brown and many films can be bleached or dyed. As a paint base Iridite provides excellent initial and retentive paint adhesion and a self-healing property which protects bare metal if exposed by scratching. Iridites have low electrical resistance. Some can be soldered and welded. The Iridite film itself does not affect the dimensional stability of close tolerance parts.

Iridites are widely approved under both Armed Services and industrial specifications because of their top performance, low cost and savings of materials and equipment.

You can see then, that with the many factors to be considered, selection of the Iridite best suited to your product demands the services of a specialist. That's why Allied maintains a staff of competent Field Engineers—to help you select the Iridite to make your installation most efficient in improving the quality of your product. You'll find your Allied Field Engineer listed under "Plating Supplies" in your classified telephone book. Or, write direct and tell us your problem. Complete literature and data, as well as sample part processing, is available. Allied Research Products, Inc., 4004-06 East Monument Street, Baltimore 5, Maryland.

For more information circle No. 110 on the Reader Service Card

180 grit belt, lubricated by belt grease. This is followed by buffing on a 16" bias buff with 86/93 thread count, using tripoli and rotating at 2100 RPM.

On the other hand, aluminum die cast portable tool housings are polished with a medium soft wheel and 220 grit alumina grit, at 1750 RPM, and lubricated with a tallow stick. This is followed by buffing on a 16" bias buff (86/93) and #3 tripoli at 2100 RPM.

Pointers to watch out for, according to Donald J. Wahler of Maplewood Companies, to get the most efficient and best quality polishing and buffing on die castings, are: use sufficient horsepower and wheel speed, and use well cooled wheels and compounds having sufficient proportion of lubricants.

The condition of the raw casting will influence choice of finishing materials and cycles, according to Mr. Badaluco of Hanson-Van Winkle-Munning, who points out, "Polishing and buffing to the highest possible smoothness and lustre on zinc die castings demands a control of endless variables necessitated by the condition of the raw casting surface condition commonly containing cold shot and flow patterns that cannot always be removed, but can be minimized or favored with properly selected polishing grain size, buffs, wheel speeds and buffing compounds.

Hammond Machinery Builders

TYPICAL GRINDING and polishing setup is this variable speed, two spindle lathe, equipped with backstands, guards and dust collector.

"Polishing with an abrasive belt or setup wheel to produce uniform smoothness prior to buffing," he says, "should be accomplished with the finest abrasive to remove blemishes as we strive to remove the least possible amount of surface metal. This is generally accomplished with grain size of 220 either of aluminum oxide or silicon carbide.

"It is absolutely necessary that a lubricant (greastick) be used not too sparingly during this operation, as the quality of polishing operation determines the buff friction pressure necessary in the subsequent buffing operation. If excessive stock removal prevails in polishing and buffing, the cold shot and flow patterns become accentuated, resulting in scrap.

"Actually, during buffing it is desirable to operate at the lowest 'practical' SFM," Mr. Badaluco comments, "to produce the lowest micro finish. However, production requirements are such that friction and friction heat must be introduced quickly at approximately 7500 SFM for practical reasons and therefore buffs are discarded because of small diameter when the best finish is obtained at about 5500 SFM."

The conclusion is that the least amount of stock removed at the slowest RPM practical, produces the lowest micro inch finish.

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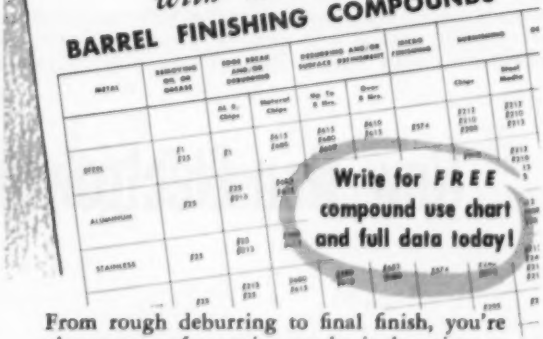

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these properties offered by nickel-phosphorus coatings . . .

TABLE 1. Properties of nickel-phosphorus coatings

Hardness and Ductility	Normal, as-plated hardness is about 49 Rockwell C, but heat treated 1 hr. at 752 F raises this to about 70 Rockwell C. Maximum ductility and impact resistance are developed by heat treating at 1382 F for 5 hrs., in inert atmosphere, followed by slow cooling to 392 F.
Electrical Resistivity	Approximately 60 microohms/cm/cm^2
Thermal Conductivity	In the order of 0.0105 to 0.0135 cal/cm/sec/°C
Coefficient of Expansion	13×10^{-6} cm/cm per °C or 7.22×10^{-6} in/in per °F
Melting Point	1635 F

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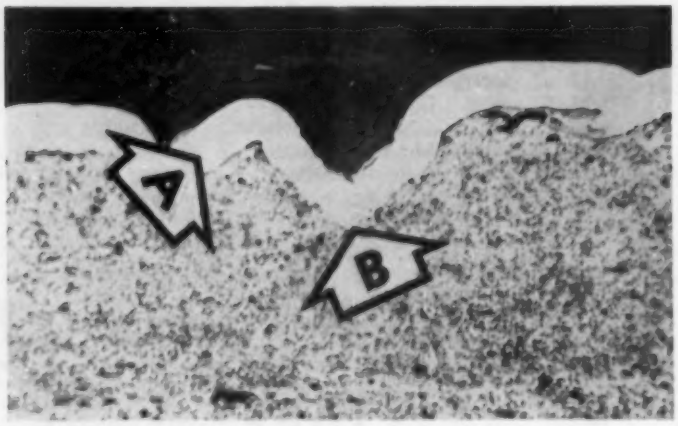


NON-POROUS coating with close conformation to the surface of the basis metal are characteristics revealed in this photomicrograph of Kanigen coating on steel. Mag. 150X.

New Non-Electrolytic

A NON-ELECTROLYTIC process for depositing a nickel-phosphorus coating on metal, originally developed to give corrosion-resistant linings to tank cars, is finding many uses on industrial parts.

Called the Kanigen process, it deposits a uniform, hard, nonporous coating of nickel-phosphorus on iron, copper or aluminum and their alloys from a chemical bath without the use of electricity. The coating (probably a solution of nickel phosphide in nickel) exhibits many desirable properties not normally associated with metals or metal plating.

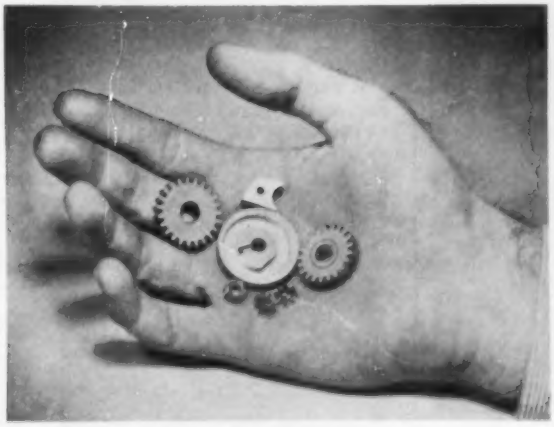
This process, developed by General American Transportation Corp., has been tried successfully on powdered iron parts and on die cast aluminum, although neither of these is yet in a production stage. Preliminary tests have been quite promising.

While it is possible to develop a brilliantly reflective surface by buffing and coloring it to a high lustre before coating, this is not primarily intended to be a decorative treatment. Its greatest applications are likely to be those that take advantage of the unique properties of the coating.

What are its unique properties? One of the most impressive qualities of the Kanigen coating is revealed

Corrosion Resistance*	
Amyl acetate (9 wk. test at room temp.)	No attack
Benzyl alcohol (4 wk. test at room temp.)	No attack
Ethyl alcohol (9 wk. test at room temp.)	No attack
Odorless Naphtha Petroleum	No attack
white oil	No attack
Photographic hypo (4 wk. test)	No attack
Amyl chloride (9 wk. test at room temp.)	0.03 mil/yr.
5% detergent solution	0.037
Gasoline	0.022
45% Lactic acid	0.29
Lemon juice	0.23
Stearic acid (70 C)	0.02
5% Acetic acid.	0.791
Fluorophosphoric acid	1.56
Nitric acid	Not Recom.
85% Phosphoric acid	Not Recom.

*This is only a partial listing of results of corrosion tests conducted by completely immersing samples in the corrosive solution with no aeration.



TYPICAL USE for the Kanigen non-electrolytic coating is the corrosion protection of powdered iron parts, such as the small business machine and camera parts.

Plating Process

by electron and X-ray diffraction studies. As deposited, these coatings have the structure of an under-cooled liquid; having no crystal structure, the coating has virtually zero porosity.

These coatings are free of voids. Conformity to the basis metal is so close that there are no observable breaches between the two. Only a gross aberration of the basis material, which might create a gas pocket, can produce this type of defect.

"Throw" is no problem, so that complex shapes and deep conformations can be coated as readily as the exposed areas. Growth of the Kanigen coating originates from multitudinous point sources, or catalytic centers, on the surface of the basis material. From these points, coating growth proceeds at equal rate in all directions. A series of "plane fronts" are created parallel to the original surface which merge to form a coating of uniform thickness, regardless of contour.

Experiments to determine the relative position of these coatings in the electromotive series have indicated that the nickel-phosphorus of which the coating is composed is somewhat less electro-negative than electroplated nickel; rate of corrosion should thus be somewhat lower with the Kanigen coating than with nickel.

In Table I are some of the other properties of the coatings which may provide some indication of most likely applications for the process.

Process factors to consider. Like electroplating, this process requires immersing the workpiece in a solution (except for extra large pieces which are plated on the inside by pumping the solution through them); but unlike electroplating, this process uses no electricity.

This consideration permits the barrel coating of many small parts that could not normally be electroplated in this manner. Since there are no problems of electrical contacts or of excessive currents, barrels can rotate at a much lower rate of speed. Parts that might be damaged by rapid tumbling action can be safely processed here. Coating thickness has the same uniformity as when done on a rack.

Gas is evolved during the process, and therefore, some thought must be given to the danger of gas entrapment within complex shapes. Some steps, such as rotating the part during processing or mounting it with proper orientation on the rack, can usually overcome this problem.

Areas where no coating is desired can be masked, but since this is comparatively expensive, should be avoided. Where parts are suspended on a wire or rack during processing, the coating will plate under the wire without a mark to a thickness of about 2.0 mils.

Absolutely clean surfaces are required before plating. Procedures for removing grease, light soil and oxides, have been developed.

Where will it be used? In the first place, the process has been found applicable on wrought iron, cast iron (especially machined surfaces), steel (including stainless), copper, brass, bronze and aluminum. Lead, cadmium, tin, bismuth and antimony cannot be coated and usually cause poor coating, thus precluding the processing of soldered or brazed pieces using tin or lead solders.

But, the process serves as an excellent surface preparation for the soldering or brazing of aluminum. A very thin coating of the nickel-phosphorus over aluminum is suitable for soldering. Tin-lead solders are said to wet the Kanigen coating readily if sufficient heat is provided (about 500 F).

While not essentially a decorative treatment, it can be used for this purpose, especially where there is a combination of appearance and protection to be gained. Starting with a highly colored aluminum die casting, for example, a thin bonding coating of the nickel-phosphorus can be applied, followed by bright nickel and chromium in the conventional manner.

The appearance of the coating is somewhat darker

Continued next page

than usual electroplated nickel, but has high reflectivity. Chromium plated over the Kanigen surface has its usual blue-white color.

Polishing or buffing is extremely difficult on the Kanigen coating because of its unusual hardness, and should be done prior to coating; however, color-buffing is very easy and can be done to bring up the surface lustre, after coating.

While the potential applications for this relatively new process have only been partially explored, there appear to be certain fields where its immediate usefulness will be recognized. Later, probably other equally significant uses will be found.

For example, the largest field at the moment is the prevention of iron pick-up or contamination. Many materials that are not corrosive to steel are, nevertheless, easily contaminated or discolored by iron oxides. In this application, the coatings have found utility value for equipment used to process bakery dough, cake mixes and other foods, chemical blending equipment, valves, pipes and fittings, dry cleaning equipment and tank cars.

Corrosion resistance of the non-porous coating has resulted in its introduction for protection of valves, pumps, filter parts and similar products.

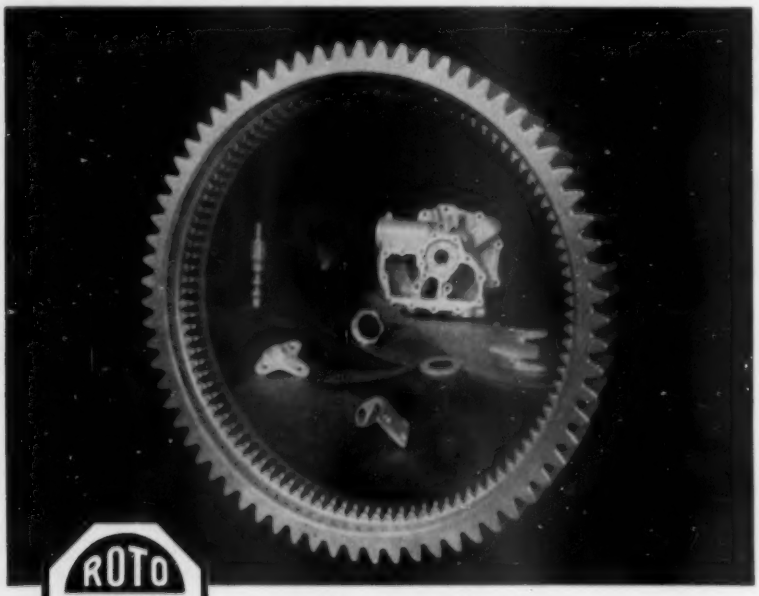
In hydraulic equipment, the wear resistance and hardness of the coatings are being sought. Particularly, the provision of harder surfaces on aluminum has been an objective in aircraft applications. Yet, where two coated parts are to rub together without lubrication, the process is not recommended.

On the stainless steels of the 300 series, and also on type 4100, the nickel-phosphorous coatings are reported to reduce the galling tendency.

A major manufacturer of cameras and a manufacturer of timing devices have conducted preliminary tests on this coating system for use over powdered iron components. The photographic equipment concern ran tests on powdered iron cams and flywheels, and reported that they had encountered neither blistering nor bleed-through, common problems in electroplating powdered metal parts. Some salt spray testing has also been reported on these parts, but results are not available.

A large commercial die casting company has also shown interest in possible use of this process for surface treatment of aluminum die castings, both as a means of increasing the physical properties of the castings, and as a possible solution to the difficult problem of production electroplating on aluminum die castings.

ALUMINUM CASTINGS can be surface coated by this process. Aircraft applications look most promising.



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BY ADDING A FOUR-SPINDLE HEAD to a standard single spindle drill press, production has been multiplied on this operation of drilling a pair of holes in each of two die castings simultaneously. The castings, used in a 3-D viewer, are machined at a rate of 400 castings per hour.

TWO HOLES ARE DRILL-TAPPED simultaneously in each of two automobile air conditioning units by the simple expedient of adding a four spindle head to a single spindle press. Four 10-32 taps are driven at a time, to give clean, uniform threading.

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BY modifying standard, off-the-shelf power tools to perform three or four operations at the same time, the Sterling Die Casting Company, Inc., of Brooklyn, N. Y., has eliminated the need for expensive, custom-built tooling.

To speed drilling of castings for 3-D camera viewers, Sterling modified a Delta drill press so that two 3/16-inch holes are drilled in each of two castings at the same time. A single-spindle drill head was replaced with a four-spindle Commander unit. In one motion the operator picks up a casting in each hand and positions them in a fixture on the drill press bed. After the two castings are drilled, the operator removes both castings and substitutes another pair. About 400 castings (800 holes) per hour are drilled.

In another application, to accelerate drill-tapping of castings for automobile air conditioning units, Sterling positioned a 10-32 drill-tap head on each side of a drill press bed. A ⅝-inch tap was installed on the Delta drill press. Three holes are tapped at the same time. Previously, separate tapping operations were required and about 250 pieces per hour were turned out. Now, about 400 per hour are turned out with the multi-tap setup.

In a third application, Sterling drill-taps two more holes in each of two of the same automobile air conditioning unit castings, at the same time. This is another case of adding a four-spindle unit to a Delta single-spindle drill press with a four-spindle unit. The operator moves 200 times to drill 800 holes per hour.

Sometimes, multi-spindle operation is not practical Sterling

Continued next page

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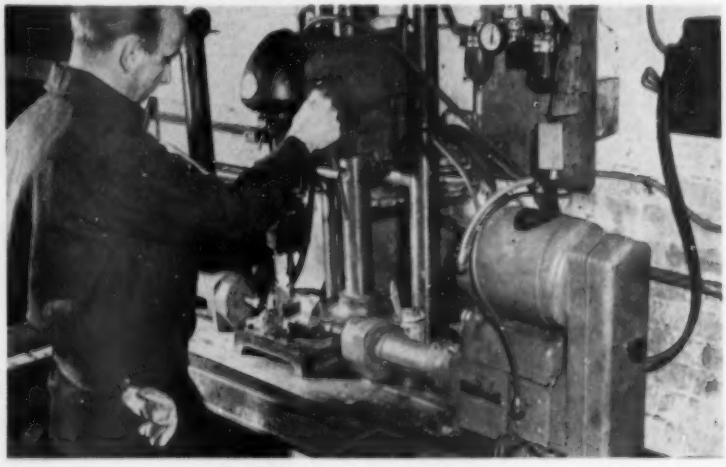
Standard Tools Can Be Made Into "Specials"— continued

BY MOUNTING THREE DRILLS on the same bed, with drills only a few inches apart, the operator can drill successive holes with great speed and accuracy, even though no multiple spindle head or air feed is used. Sometimes the location of the holes makes multiple-drilling impractical, but a setup like this one can be economically used.



PRODUCTION RATE HAS CLIMBED from 250 to 400 castings per hour on this triple tapping operation. The operator uses a Delta drill press with ⅝" overhead tap while two 10-32 drill-tap heads are feeding in from the sides.

found. Castings of oil meter bases require holes spaced in such a way that three drill presses are necessary. For this operation Sterling mounted the drill presses on one bed with the spindles only a few inches apart. About 150 castings per hour are turned out.

According to Walter Pullan, shop foreman, each of the modifications has more than paid for itself. Each setup provides both the ruggedness as well as the efficiency of more expensive tooling installations at a substantial saving.

USEFUL LITERATURE, CATALOGS, MANUALS

any of these technical publications may be obtained by circling the appropriate numbers on the Reader Service Cards, Pages 16-17.

PROCESSES

Reducing Parts Costs: 154
Yale & Towne Mfg. Co., 14-page, 2-color brochure. How to reduce the costs of individual components through the use of powder metallurgy is told in this brochure.

Carbides & Heavy Metal: 155
Welded Carbide Tool Co., 5 separate specification sheets. The physical and mechanical properties of the several different carbide and heavy metal materials available are given. Uses for each are suggested.

Bushings & Structural Parts: 156
Johnson Bronze Co., two, 4-page folders. The properties of self lubricating bushings and the sizes available from stock are listed. Some data and descriptive material on structural parts.

High Precision Gears: 157
Supermet Div., Globe Industries, Inc., 2 page data sheet. The production of high strength, high precision gears by powder metallurgy is discussed. Gears up to and including commercial class 4 tolerances are made by this process.

High Strength Sintered Parts: 158
Burgess-Norton Mfg. Co., 4 page brochure. A description of the sintered parts made by this company. Minimum tensile strength claimed is 50,000 psi and minimum density 6.2 g/cc.

Investment Castings: 159
Kolcast Industries, Inc., 15 page booklet on use and design. A description of the frozen mercury process for making investment castings, examples of a few of the many types of castings made and a description of the facilities available for engineering and production.

Oilite Bronze Bearings From Stock: 160
Amplex Division, Chrysler Corp., 22 page catalog, Stock List S-56. Complete listing of sleeve, flange and thrust bearings of Oilite Bronze that are being stocked now by dealers in U.S. and Canada, reveals a 50 percent increase in bearings available from stock. A total of 1050 different, bearings are included in the comprehensive catalog, which lists sizes ranging from ⅛" to 4" ID, as well as a selection of cored, bar and plate stock; also in the catalog are six pages of engineering data.

Aircraft Steel Castings: 161
Lebanon Steel Foundry, folder contains two case histories on steel castings produced by Ceramicast Process for use in aircraft built by Chance Vought and Bendix. Solution of difficult problems with regard to shape, alloy and physical properties is reported.

MATERIALS AND EQUIPMENT

Alloy Steel Goosnecks: 162
Dodge Steel Co., 1 page, bulletin FP 356. A description of the alloy steel goosnecks made by this company. Longer life, easier maintenance, reduced down time, etc. are claimed.

Cold Molding Compounds: 163
The Perma-Flex Mold Co., Loose leaf bound folder with data sheets, prices, reprints, and technical data. This is a compilation of many of the individual bulletins that have been published on the cold molding compounds sold by this company.

Extruded Wax Shapes: 164
J. Yates Dental Mfg. Co., 8 page brochure. The use of extruded wax shapes in the investment casting industry is covered and many of the different shapes and sizes are listed. Data include the approximate feet per pound for each shape and size as well as the price per lb.

Cutting Oil: 165
Fiske Bros. Refining Co., 1 page leaflet. A brief description of a new cutting oil and some of its applications in the machining of a wide variety of materials.

Meehanite Metal: 166
Meehanite Metal Corp., bulletin No. 32, 4 pages and bulletin No. 35, 34 pages. These two bulletins give all of the properties in tabular form of the metal and a wide case history report showing many different types of castings with performance data for each.

Mold Parts, Tools and Supplies: 167
Detroit Mold Engineering Co., 31 page catalog. A catalog of standard mold parts, tools and supply items and mold polishing supplies for the plastic and die casting industries.

Metallurgical Carbon: 168
Barneby-Cheney Co., 1 page metallurgical report. A new report on metallurgical carbons giving chemical and physical characteristics of these materials. The report also gives tables of grades, elemental carbon content, mesh sizes, etc.

Zinc Die Casting Alloys: 169
Henning Bros. & Smith, Inc., 22 page booklet on die casting alloys. A summary of much otherwise scattered data on zinc, lead and aluminum base die casting alloys. Numerous data are included for each alloy.

Automatic Controls: 170
Automatic Temperature Control Co., Inc., 19 page general catalog. A general catalog listing all of the standard items produced by this company. A short description of each unit is given and a reference number for literature in more detail where wanted.

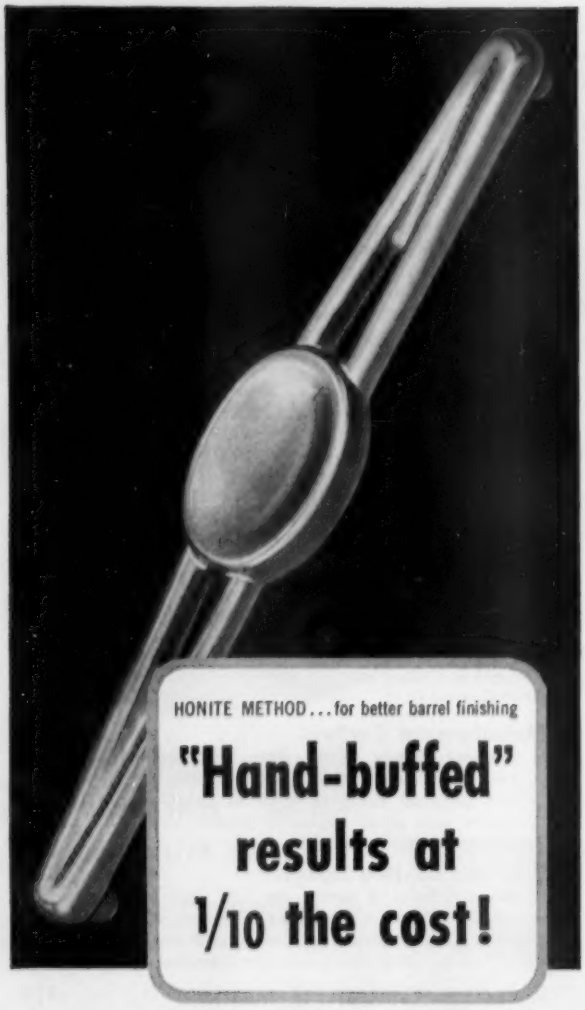
Silicones for Shell Molding: 171
Union Carbide & Carbon Corp., Silicones Div., booklet on the uses and applications of three different silicone preparations LE-46, LS-46 and L-46, that have found wide application in the shell mold casting industry.

Colloidal Dispersions: 172
Acheson Colloids Co., 4 page brochure. A revised listing of the 41 different colloidal and semi-colloidal dispersions for industrial use that are now available from the company. Properties and suggested applications are given.

Magnesium Applications: 173
Dow Chemical Co., external house organ "Magnesium Topics". The latest issue of this publication gives a number of examples of some of the newer uses for magnesium. Noted also are some of the more unusual applications.

Continuous Furnaces: 174
Harper Electric Furnace Corp., bulletins No. 454 and 1054. Descriptive material on both continuous and batch type furnaces for powder metallurgy and general heat treating. One bulletin deals exclusively with continuous mesh belt furnaces.

Continued next page



This die-cast aluminum handle for furniture is one of several thousand processed each month by a Cincinnati, Ohio manufacturer. The handles must be given a super-smooth finish prior to plating—a job formerly done by rough finishing with a competitive barrel finishing abrasive, then *hand* buffing to produce the desired finish. The hand buffing cost was prohibitively high.

Recently, this company switched to the HONITE Barrel Finishing Method, using a 2-step process—cutting with Regular HONITE Chips and HONITE Micro-Cut Compound, then polishing with HONITE Multi-Burnish Compound.

This method produces the same quality finish as hand-buffing, at 90% lower cost!

You, too, can cut costs with the HONITE Barrel Finishing Method. Call your nearby HONITE Sales Engineer today. Or write for free booklet: "Facts and Figures Report on Honite Barrel Finishing". Address: Minnesota Mining and Manufacturing Co., Dept. FF-66, St. Paul 6, Minn.

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Made in U.S.A. by Minnesota Mining and Mfg. Co. General Offices: St. Paul 6, Minn. In Canada: P.O. Box 757, London, Ontario. Export Sales Office: 99 Park Avenue, New York City. Makers of "Scotch" Brand Pressure-Sensitive Tapes, "Scotch" Brand Magnetic Tape, "3M" Adhesives, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing.

For more information circle No. 118 on the Reader Service Card

USEFUL LITERATURE

continued from page 71

Sintering Furnaces: 175
Lindberg Engineering Co., two bulletins, Nos. 260 and 230 as well as two reprints. Furnaces and furnace atmospheres for sintering bright annealing and bright hardening are discussed.

Metal Powder Presses: 176
Baldwin-Lima-Hamilton Corp., four bulletins, Nos. 3102, 3103, 3104 and 3100. A description of the different presses available for compacting metal powders.

Sintering & Heat Treating Furnaces: 177
The Electric Furnace Co., six brochures and data sheets. Descriptions of furnaces for sintering and heat treating. Included is information on controlled atmosphere generators.

Tools & Presses for Powder Compacting: 178
Haller, Inc., 2 data sheets. A description of the model 2035 press for compacting metal powders. Also information on standard and special tools for powdered metal test bars.

Sintering Furnaces: 179
Drever Co., 10 page bulletin, No. B-101. A complete description of several of the furnaces, both continuous and batch type, built specifically for metal powder sintering and oxide reduction.

Rotary Tableting Machines: 180
F. J. Stokes Machine Co., 6 page folder. A description and specifications for models 533 and 540 rotary tableting machines adaptable for powder metallurgical operations.

Ammonia Service: 181
Hammler Industries, Inc., 4 page brochure. A description of the services, equipment and dissociators available.

Metal Powder Presses: 182
Kux Machine Co., three brochures. A complete description and illustrations of the various presses designed specifically for compacting metal powders.

High Speed Presses: 183
Arnhold Ceramics, Inc., one page specification sheet. A description of and the specifications for the Dorst Press, a European built unit designed specifically for powder metallurgy work.

New Iron Powder: 184
Alan Wood Steel Co., 5 page data book. A compilation of the properties of a new iron powder just offered. Complete information is included to evaluate dimensional change, physical properties and mechanical properties of compacts made from this powder.

Brass Powder: 185
The New Jersey Zinc Co., 24 page book on brass powder metallurgy. The applications of powdered brass to the manufacture of parts and the properties of sintered brass parts are given. Methods of handling brass powder are included.

Industrial Chemicals: 186
Antara Chemicals Div., General Aniline & Film Corp., 40 page catalog. Listed are all of the detergents, wetting agents, emulsifiers, brighteners, etc. made by this company. For each product a brief description, packaging information, and some general remarks as to uses are given.

Alloy Powders: 187

Alloy Metal Powders, Inc., 4 page report. A comprehensive report on the procedure for making sintered parts from stainless steel, particularly the 300 series. Included is the analysis of the different alloys available and the physical and mechanical properties of the powders and of compacts made from them.

Iron Powder: 188

Plastic Metals Div., National-U.S. Radiator Corp., Bulletins No. 1, 2 and 3 and two reprints. The literature gives a general discussion of powder metallurgy, electrolytic iron powder and special sponge iron powders.

Iron Powder: 189

Hoeganaes Sponge Iron Corp., two 4 page brochures. The properties of this sponge iron are given in detail and information as to the type of sintered part that can be made. The latest price sheet is included.

Resin-Coated Sand For Shell Molds: 190

Plastics Div., Monsanto Chemical Co., 16 page booklet. Ways in which resin-coated sand is more efficient than resin-sand mixtures for producing shell molds are outlined in this booklet which has sections devoted to: resins, sands, equipment, coating techniques and the production of blown shell molds and cores.

Analyzing Vacuum Furnace Gas: 191

Consolidated Electrodynamics Corp., Bimonthly publication, "CEC Recordings," 16 pages illustrated. Two articles of special interest are contained in Vol. 10, No. 2 of this publication: "Analyzing Vacuum Furnace Gases" and "Looking Into Petroleum Waxes."

Service begins before installation to make cleaning or phosphate coating requirements before paint... And Neilson service continues after the sale to assure you of sure the proper PREP PRODUCTS and PROCESS is selected for your metal maximum performance and economy! Why not benefit from Neilson's 25 years of metal conditioning experience?

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Tapering wall thicknesses and scientifically designed side-wall angles resist swelling and distortion. Tough, durable low nickel-chromium alloy cast iron absorbs heat rapidly and retains it with minimum heating requirements. Resists oxidation. Fast delivery on all styles and sizes, standard and special. Also available are . . . tough, close-grained goose-necks . . . smooth-surfaced ingot molds . . . many types of acf quality utility castings.

Send to Dept. PM-F for free catalog of standard acf melting pots.

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WHAT'S THE FASTEST WAY TO CLEAN METAL?
See page 11
WHAT'S THE MOST ECONOMICAL WAY?
See page 9
Some good things to know about Metal Cleaning
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USEFUL LITERATURE

continued from page 73

FINISHING

Barrel Finishing: 191

Almco Div., Queen Stove Works, Inc., 6 page reprint. A reprint of an article on the use of fixtures in barrel finishing of large parts. Much basic information is included.

Plating Rheostats: 192

Hanson-Van Winkle-Munning Co., 4 page bulletin CPR-200. This bulletin describes and illustrates the company's universal carbon pile tank rheostats. Operational data are given along with dimensions and suggested panel lay-outs.

Precision Drill Blanks: 193

Whitman & Barnes, use and application data. Information on a complete line of drill blanks for use as punches, knock-out pins, gages, dowels, etc. The blanks are hardened and ground to ±0.0003 on production blanks or closer tolerances if ordered.

Electrostatic Spray System: 194

Scientific Electric Co., Ionic Spray Div., data on new paint spraying system. Literature is available on a new ionic paint spray system said to have an adjustable spray pattern. Work to be painted is at ground potential.

Conversion Coating for Aluminum and Zinc: 195

Oakite Products, Inc., Literature describes a new product, a conversion coating for aluminum and zinc designed to meet Specification MIL C-5541. Called ChromiCoat, the material is said to become an integral part of the metal surface, helping to resist corrosion and improve paint adherence. Operation is in either tank or washing machine, using concentrations of 2 to 3 ozs/gal. of water at temperatures to 100 F.

FLOATING DIES...

FOR UNIFORM DENSITY IN POWDERED METAL...

...TEST PARTS TENSILE BARS, TEST BUSHINGS, GREEN STRENGTH SPECIMENS...

...and others needed for laboratory and production line inspection of physical properties. Self contained tools are made to MPA standards and can be set up quickly in any hand or laboratory press.

HALLER Incorporated
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LETTERS

continued from page 33

Would you know of any light-metal foundries that either specialize only in experimental work or that have a separate facility set up to handle these orders. I believe that other firms would also be interested in such a service.—E. B. S. (Engineering Department)

Yes, we do know of a number of foundries that will do this type of work. Two of the processes which we cover editorially are very often used for short run experimental jobs in aluminum, although not all foundries producing by these methods are interested in prototype work. However, we have sent the names of a number of investment casters and plaster mold casters whom we know have produced prototype castings in aluminum.

Tooling costs for either of these processes will not be prohibitive, and, considering the closeness with which they can meet your dimensional tolerances, their piece costs will not be excessive, either. Either process can readily meet average dimensional limits of ± .005 and give you smooth surfaces needing little finishing.

Tear sheets of a couple of PMM articles on the subject have also been forwarded.—Ed.

DATA IN ADS

continued from page 20

110. Finishing Non-Ferrous Metals—Detailed laboratory and engineering reports on the finishing of non-ferrous metals by the Iridite process are available from Allied Research Products, Inc.

113. Painting With Masks—Literature on spray masks, mask washers, automatic spray painting machines and clamps and fixtures is available from Conforming Matrix Corp.

115. Barrel Finishing Compounds—A complete chart and data file on the proper barrel finishing compound for almost any part or material are available from Esbec Barrel Finishing Corp.

116. Surface Finishing Equipment & Supplies—Hanson-Van Winkle-Munning Co. has a number of bulletins describing their equipment, supplies and compounds designed especially for finishing aluminum.

117. Threaded Inserts—Three bulletins on threaded inserts are available. One is an application chart and two are design data. All three can be secured from the Heli-Coil Corp.

118. Barrel Finishing—A facts and figures technical report on barrel finishing by the Honite method is available from Minnesota Mining & Mfg. Co.

119. Small Parts Drying—A four page folder on the centrifugal, air drying of small parts has been issued by New Holland Machine Co.

121. Metal Cleaning—Oakite Products, Inc. have issued a booklet on metal cleaning entitled "Some Good Things to Know About Metal Cleaning."

123. Bright Plating Process—Complete details on bright plating are given in a brochure that has been issued by Sel-Rex Precious Metals, Inc.

124. Barrel Finishing Media—Speed-D-Burr Corp. has catalogs available on barrel finishing machines, media, compounds and material handling equipment.

122. Barrel Finishing—The new catalog from Roto-Finish Co. gives much of the pertinent information needed to barrel finish a wide variety of parts. Different metals and parts sizes are thoroughly discussed.

125. Induction Melting—The advantages of induction melting in better alloy control, closer temperature control and other important items of melting practice are discussed in detailed literature from the Inductotherm Corp.

This man is helping cut small parts drying time just about one-half . . .

Model 20 New Holland

KREIDER

Centrifugal Dryer

AIR-DRIES...as it SPIN-DRIES!

Now you can *spin-dry* small parts in continuous *fresh air* in as little as 15 seconds . . . cut drying time *just about one-half.*

Double-action drying gives you smooth moisture-free surfaces . . . reduces your finishing problems by eliminating the scarring and marring frequently responsible for costly "rejects."

Speed production . . . cut costs way down with New Holland's easy-to-run Model 20 Kreider Centrifugal Dryer.

Choose from 3 models engineered to meet your requirements: — Standard Model; Standard Model with Supplementary Electric Heat; Standard Model with Supplementary Steam Heat.

— SPECIFICATIONS: —

1 h.p. motor—220, 440, 550 volts—2- or 3-phase—spins 75 lb. loads at 825 r.p.m. . . . Quiet V-belt drive . . . 30-blade suction turbine draws air through spinner . . . Arc-welded steel-plate construction . . . Heavy-gauge woven steel mesh basket . . . Weight: 490 lbs. . . . Floor space: Just under 5 sq. ft. . . . Meets N.F.C. Specs. **Optional:** J.I.C. Control: Mounted on right, left side or wall. 160° supplementary heat: 2350-watt Chromalox, or steam.

Send for illustrated 4-page folder. Address Dept. PM-66 New Holland Machine Company New Holland, Pa.

New Holland Machine Company

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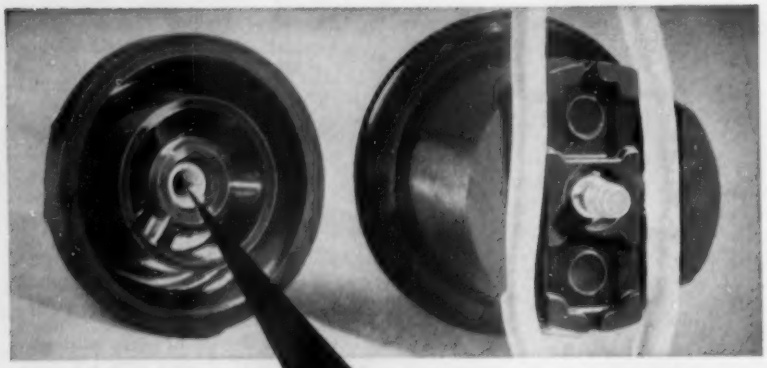

PIP* **push inserts make perfect threads**

WITHOUT TAPPED HOLES OR SOLID BUSHINGS

Threads without tapping at less than 1¢ per hole installed. Just push-in-place a PIP Push Insert and you have perfect female threads in cast, molded or drilled blind or through holes. Spring-like PIP Inserts lock securely in place in plastic, aluminum, zinc and all other molding and die-casting materials.

The illustration shows a typical application. The PIP Insert in the cap of this common electrical socket provides threads strong enough to impale the two covered wires on contact prongs. The insert was pushed into a plain cored hole after molding, avoiding long cycle time required by molded-in solid bushings.

PIP Push Inserts are perfect for production line application. Either a drill press, kick press, arbor press or air piston —and a few dollars in tooling—are all you need to install perfect threads in 1,200 holes per hour.

Write today for samples and full information.

*Product of Heli-Coil Corp. —Pat. Pending

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☐ Send Standard PIP Push Insert Application Chart and other information on this new technique.

☐ Send design data on *Heli-Coil* Screw Thread Inserts.

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IN CANADA: W. R. WATKINS CO. LTD., 41 Kipling Ave. S., Toronto 18, Ont.

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CAMERA CASTINGS

continued from page 41

the main body of the camera. Threads cut cleanly in zinc and will not score or strip easily during assembly or disassembly of the camera for inspection and repairs. After machining, the front end of the camera and main housing are Bonderized, primed, and given two coats of black, crackle finish.

Many of today's lower-priced cameras are made of plastic materials. These serve reasonably well under normal conditions but heat will cause them to warp. For instance, if left in a closed automobile in extremely hot weather or in a glove compartment at anytime of year the frame of a plastic camera may become deformed, thereby misaligning the optical system. But Linex's zinc die cast camera is dimensionally stable, maintaining critical, fixed focal distance and shutter speed under wide range of humidity and temperature.

The Linex camera has been tested in a simulated climate control laboratory under extreme atmospheric variations. It passed these tests satisfactorily and the results were due in no small part to the use of corrosion resistant stable zinc base alloys.

RELEASE NEW MOVIE ON ELECTROPLATING

Bart-Messing Corporation of Belleville, N. J., announces the completion of an educational motion picture with sound, dealing primarily with the electroplating facet of metal products finishing.

Entitled "A Brighter Tomorrow" this 16 mm technicolor film which runs approximately 30 minutes, visits the various plants of the Bart-Messing Corporation where a number of interesting metals finishing processes and applications are observed and described. It gives a panoramic view of electroplating, from the anti-corrosive electro-deposits of nickel on airplane propellers, steel sheets and pipes and fittings, to the functional or decorative electroplating of gold, rhodium and silver on electrical or electronic components, jewelry and various household articles.

A print of "A Brighter Tomorrow" is available free of charge to qualified organizations for showing at sales meetings, conventions, educational seminars.

ELECTROPLATERS MEET IN JUNE; 40 PAPERS ON FINISHING SCHEDULED

Forty papers embracing electroplating, metal finishing and related fields will be presented at the 43rd annual convention of the American Electroplaters' Society in Washington, D.C., June 18-21, 1956. A yearly convention highlight, (the educational program) features top men who give the latest advances in their respective fields.

Ten sessions—four of them of the dual variety and one triple—promise AES members a full program of education at the Hotel Statler. The tentative educational program: Monday, June 18—1:30 PM to 4:00 PM; Tuesday, June 19—9:00 AM to Noon, 7:00 PM to 9:00 PM; Wednesday, June 20—9:00 AM to Noon; and Thursday, June 21—9:00 AM to Noon.

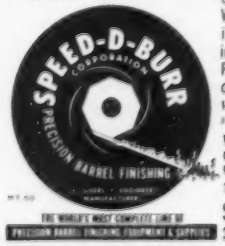
DURING ELECTED BANK DIRECTOR

William J. During, vice president and director of Harsco Corp., has been elected a director of the Marine Midland Trust Company of Central New York, according to an announcement issued by Harry W. Davies, Chairman of the bank's Board of Directors. During is also president and director of Precision Castings Co., Division of Harsco Corp., executive vice president of C. C. Bradley Company and executive vice president of Edlund Machinery Corp. He is president of Syracuse Cigarette Service Company, American Die Casting Institute, and the Syracuse branch of National Trades Association.

it's the SHAPE that counts!

ALL NEW... Speed-D-Burretts*
Controlled Size and Shape
ABRASIVE MEDIA for PRECISION BARREL FINISHING

Outlasts other media as much as 10 to 1
Controlled grain size Aluminum Oxide bonded firmly with specially formulated synthetic rubber to allow finishing of precision parts hitherto impossible to barrel finish. Molded and cured to controlled hardness that assures long life, maximum cushioning yet gives desired cutting, honing or polishing action. May be used with any equipment.
New "Burretts" permit abrasive action in the most remote corners and recesses of delicate, precision parts. Will not chip or splinter into odd shapes that lodge in blind or threaded holes. Prevents broken chip damage to expensive parts.
*Pat. Pend.



Write for catalog of prices, sizes, shapes and grits—today!

Write for catalogs on:
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Service is our most important product . . . Use it!

SPEED-D-BURR CORPORATION
3613-e San Fernando Road, Glendale 4, Calif.

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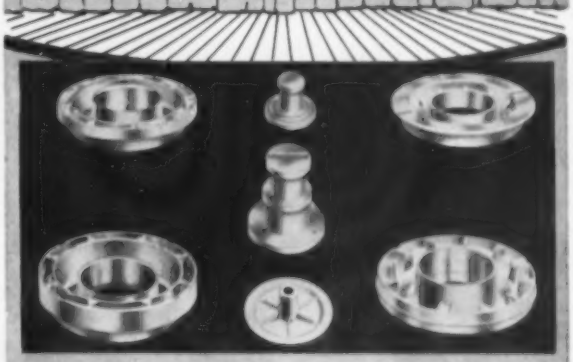

SERVO and CONTROL PISTONS . for AUTOMATIC TRANSMISSIONS by LITEMETAL

Within the past 5 years new equipment and techniques have made possible the die casting of aluminum Servo and Control Pistons for automatic transmissions. Previously, die casting proved unsuitable for components such as these. Now, die cast by LITEMETAL, these pistons push, pull and control in accordance with rigid engineering specifications and standards . . . they represent the practicability of aluminum die castings in hydraulics for the automotive and industrial fields.

Aluminum or magnesium die castings by LITEMETAL have almost unlimited applications and are used extensively . . . being mechanically strong, dependable . . . and economical. Besides effecting great savings in time and materials, the die casting process virtually eliminates costly labor otherwise required for machining and finishing. In addition, the savings in weight facilitate inplant handling and often greatly reduce shipping costs.

Let's Talk It Over . . .

LITEMETAL DICAST, INC. is an organization of specialists — men thoroughly experienced in the casting and machining of magnesium and aluminum alloys. Our equipment includes big machines for big jobs — little machines for little jobs . . . the right sizes and types of the most modern die casting equipment for producing parts from the size of a button to large cable spools. Complete facilities for secondary operations are also available.

Write today for literature and design information. Quick action on inquiries.

LITEMETAL DICAST Inc.
A DIVISION OF HAYES INDUSTRIES
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PLANT AND EXECUTIVE OFFICES

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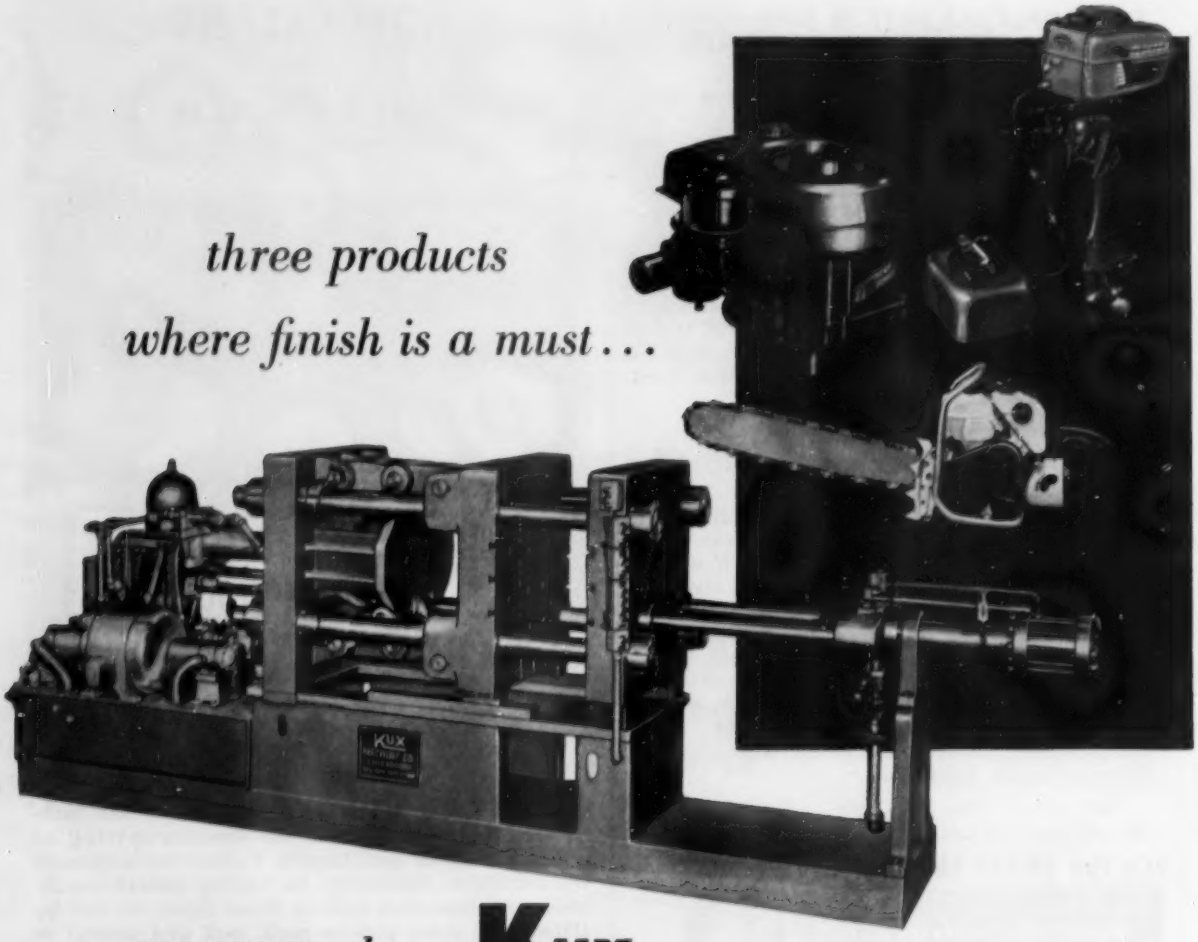
three products

where finish is a must . . .



so CLINTON *chose* KUX

DIE CASTING MACHINES

to get hardware finish quality castings

Every sales manager has told his production department at one time or another, "The product's fine, but you've got to dress it up."

At which time the production man starts talking about increased costs.

But many manufacturers have found they can "dress up" their products, and at the same time, *lower* manufacturing costs.

The Clinton Machine Company, Clinton, Michigan, did just that. "We use Kux Die Casting Machines in the manufacture of approximately 60% of the component parts of our Clinton engines, chain-saws and outboards.

"We chose Kux because our standards require machines that give us a dense, hardware quality finish with castings to close tolerances. The efficiency and low maintenance costs of Kux Machines have cut our production costs sharply, too," says R. E. Porter of Clinton Machine.

KUX produces a full range of modern die casting machines that require only the touch of an electric button to put them automatically through a complete casting cycle at high production speeds. Kux engineers will be glad to show you how die casting machines can serve you, or write for an illustrated catalog.

MODEL HP 37 ILLUSTRATED

Hydraulically operated die casting machine for production of aluminum casting weighing up to 10 pounds.

KUX MACHINE CO. 6725 NORTH RIDGE AVENUE • CHICAGO 26, ILLINOIS

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NEWS OF INDUSTRY & ASSOCIATIONS

activities of people, companies & groups in the precision metal molding industries

TRICHEL NAMED PRESIDENT OF AMPLEX DIV., CHRYSLER

Appointment of G. W. Trichel as president of the Amplex Division of Chrysler Corporation has been announced by I. T. O'Brien, group executive in charge of special products.

In his new post Trichel succeeds A. J. Langhammer, who has been operating head of the Amplex Division since its inception in 1929 and president since August, 1940. Langhammer is retiring June 30 and will act as a consultant until that time.

G. W. Trichel

Trichel has been executive vice president and general manager of Amplex since July, 1954. The Amplex plant in Detroit, produces each month in excess of 12 million pieces of various types of Oilite powdered metal parts, a portion of which is utilized in Corporation cars and trucks and the balance is sold through a distributor organization.

Trichel joined Chrysler Corporation in 1946 on the staff of the vice president and general manager, serving until 1951 as special advisor on defense contracts for tanks, tank engines, range finders, jet engines, and other military products.

From 1951 until his appointment to the Amplex Division, Trichel was a vice president and member of the board of directors of the Fargo Division of Chrysler Corporation.

Prior to joining the Corporation, he spent 30 years of active duty with the United States Army, advancing from Second Lieutenant in 1918 to Colonel in 1942.

AUSTENAL APPOINTS TWO VICE PRESIDENTS

Dr. Paul F. Collins and Albert M. Talbot have received vice presidential posts at Austenal Laboratories, Inc.

Dr. Collins formerly was vice president in charge of the Microcast Division and will now direct the operations of all three Austenal divisions in his new post. Mr. Talbot will replace Dr. Collins as head of the Microcast Division, retaining his position as Director of Research.

Dr. Collins, who holds a doctorate in ceramic engineering from Ohio State University, joined Austenal in 1941. He helped organize the Microcast Division early in World War II to meet the need for aircraft investment castings and directed its operations until his present appointment. Mr. Talbot joined Austenal late in 1953 following 18 years as a research metallurgist with International Nickel Company at Bayonne, N.J.

MAGNESIUM ASSOCIATION SETS MEETING DATES

Meetings of 1956 were announced by The Magnesium Association today. As has been its practice in the past, Association programming stresses applications of magnesium.

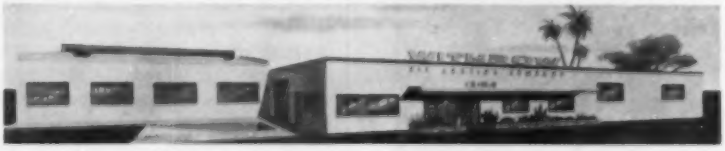
The major meeting of the year will be the Annual Convention of the Association scheduled for Thursday and Friday, October 4 and 5, at The Drake, Chicago, Illinois. This meeting normally draws an attendance of over 500.

Meetings of the Casting Division and the Fabricating Division of the Association, normally held as independent group functions, this year are being combined in a 3-day session which will have the Hotel Bancroft, Worcester, Mass., as its headquarters.

This 3-day program is divided so that the entire day of April 17th will be devoted to the problems of casting magnesium; April 18th

Continued next page

WITHROW DIE CASTING BUILDS NEW WEST COAST PLANT



The Withrow Die Casting Company, manufacturers of aluminum and zinc alloy die castings, this month move into a new, enlarged plant constructed at 13164 Leadwell St., North Hollywood, Calif.

The company is headed jointly by Joseph Haber, president and Curt Levinson, secretary-treasurer and sales manager, who acquired it in 1949. Other members of the executive team include Lester Merchant, plant superintendent and Charles Maxim, purchasing agent. Ace Boultinghouse, head of Ace Engineering and Manufacturing Co., a Withrow subsidiary, will join the parent company in its new home.

The single-story structure, 18,000 square feet in size, is being built by the Los Angeles contracting firm of Gavin and Hardy, and according to Haber, will be one of the most modern plants of its type on the Pacific Coast. Representing an investment in excess of $150,000, the structure will be three times the size of its present headquarters, containing facilities capable of doubling its output.

will be given over to a plant visit to the Wyman-Gordon, Grafton operation and to the Worcester Pressed Steel plant; April 19th will be devoted to the problems of fabricating wrought magnesium products.

LEHIGH CLUB HONORS R. L. McCANN

R. L. McCann, president of The New Jersey Zinc Company, New York, was the recipient of the sixteenth annual L-in-Life award presented by the Lehigh University Club of New York. Mr. McCann was honored May 15 at a reception and dinner.

Starting his employment with the Franklin-Sterling mining operations of The New Jersey Zinc Company in Sussex County, New Jersey, in 1917, following his graduation from Lehigh with a degree of Engineer of Mines, he progressed through various divisions of that organization to become its superintendent in 1930. He was made general manager of mines for the company in 1939, vice president in 1950, and president in 1951.

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WAIMET ALLOYS IS NEW DIVISION OF CONSOLIDATED

WaiMet Alloys Co. is a new division of Consolidated Foundries & Mfg. Co., it has been announced. Consolidated has acquired certain assets of WaiMet Engineering Company which have been merged with the facilities of the Michigan Standard Alloy Casting Co., formerly devoted to production of Master Alloys, to form a completely integrated operation under the new WaiMet Alloys Co.

The new division, with manufacturing, sales and research centralized at 1999 Guoin St., Detroit, Mich., will specialize in the production of Master Alloys to custom, as well as all nationally recognized metal specifications, for the precision foundry industries.

Roger F. Waindle, as president of WaiMet Engineering, now becomes president and general manager of WaiMet Alloys. He is well known in the foundry and metallurgical fields, and is currently on leave to serve as foundry industry representative to the Department of Commerce in Washington.

CANADIAN FIRM STEPS UP ALUMINUM OUTPUT

A 250-million dollar program for the proposed construction of a great new hydroelectric project on the Peribonka River in Northern Quebec to support a minimum of 150,000 tons of new aluminum smelting capacity in the Saguenay District of the Province has been announced by Nathanael V. Davis, president of Aluminium Limited.

Mr. Davis said that the company's subsidiary, Aluminum Company of Canada, Ltd., is negotiating with the government of the Province of Quebec for rights to develop 800,000 horsepower on the upper Peribonka River.

"If the rights are obtained and if further studies confirm the belief that the development will be attractive, construction will begin shortly," he added. First power would be generated by the new station in about three years, provided a start on construction is made this summer.

The president said that assuming both the new Quebec expansion and the construction program at Kitimat, British Columbia, are advanced without delay the company's Canadian aluminum capacity will be increased from 650,000 tons at the end of 1955 to a figure in excess of one million tons at the end of 1959.

OFFERS VACUUM-MELTED ALLOY FROM NEW INSTALLATION

A new vacuum-melting furnace and new metallurgical-chemical analysis equipment have been added to expanded facilities available to the metalworking industry for alloy experimental and production work by Cannon-Muskegon Corp., Muskegon, Mich.

According to George W. Cannon, Jr., president, the especially engineered vacuum furnace has been installed by Cannon-Muskegon to meet the constantly increasing pressure for improved alloys in corrosion-resistant, high-temperature and high wear or stress applications.

The company will continue output of conventional air-melt alloys that it has produced since its establishment in 1952. In addition, Cannon-Muskegon's plant includes research and experimental facilities for investment casting, shell molding, sand molding and permanent mold casting, ingots and billets.

"Although a number of vacuum-melting furnaces are already installed in the United States", Cannon commented, "The majority of these furnaces are not available for outside experimental or production use."

Cannon-Muskegon's furnace is primarily intended for production of iron, nickel, and cobalt-base alloys up to temperatures of 3000 F. The new facilities are being offered to industry as follows:

(1) Making cast bars, ½-inch to six inches in diameter, cut to size for remelting. These materials will be largely absorbed by the investment casting industry for further processing by conventional air-melting, inert-gas, or vacuum methods.

(2) Development work on vacuum castings.

(3) Producing cast ingots and billets up to about 250 pounds each for processing by rolling, forging, extrusion, or machining.

"We can pour 300-pound heats in an average melting time of about three hours," Cannon stated. "Our aim this year is a production rate of 20,000 pounds per month. Eventually, we may increase this by using a larger melt and adding additional pumps. For the present, vacuum alloys are priced in the range of $3.00 per lb. above the cost of corresponding air-melted alloys."

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how to keep non-ferrous metals

from fingerprinting, staining and discoloring

Many non-ferrous metals readily oxidize in the presence of moisture and industrial fumes, or a marine atmosphere. This condition is accentuated by perspiration caused from handling, and materializes in some of the following forms:

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(b) Multi-colored parts, caused by variance of processing time.

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TECHNICAL SESSIONS HIGHLIGHT SPRING MEETING OF INVESTMENT CASTING INSTITUTE

A near-record attendance participated in two days of technical and business sessions as the Investment Casting Institute held its Spring meeting in New York City May 10 and 11. The general meetings were preceded by a day of intensive committee activities.

Important actions taken by the young organization of investment casters and suppliers include the completion of work on dimensional tolerances for investment castings, and plans for publication of a design manual later in the year.

Considerable progress was reported in many committee programs, including physical and non-destructive testing, process materials and metal specifications. A standard test bar was amended and approved.

Topics covered in the day of technical papers included: "Production of High Strength Steel Castings" by Geoffrey W. Paget, superintendent, Precision Casting Department, Deloro-Stellite.

"Decarburization In Investment Casting" by Dr. Nicholas J. Grant, Department of Metallurgy, Massachusetts Institute of Technology.

"Investment Precision Casting —Methods and Possibilities of the Shaw Process" prepared by Adam Dunlop, Director, Shaw Process Ltd.

"Economics of Vacuum Melting for Investment Casters" by F. Kenneth Iverson, Chief Metallurgist, Cannon-Muskegon Corp.

"Investment Casting Gating", a panel including P. L. Butler of Arwood Precision Casting Co., W. A. Dubovick of Engineered Precision Casting Co., and C. W. Schwartz of Misco Precision Casting Co.

Comparison of metal fabricating processes was an important portion of the business meetings, including

Comparison of invesment casting with three competitive processes was a feature of the business sessions, with shell molding covered in a paper prepared by R. S. Banister, manager of Investment Casting Division of Midwest Foundry; powder metallurgy by K. M. Bartlett, executive vice president of Horizons, Inc.; and forging by F. D. Lordi, supervisor of manufacturing, Precision Casting Foundry, General Electric Co.

Roger F. Waindle, president of WaiMet Alloys Co. and chief of the Casting Branch, Iron & Steel Div., BDSA, U.S. Department of Commerce, urged action by the investment casters in a talk on "Government Planning and the Investment Casting Industry."

Presiding over the three days was Vincent S. Lazzara, president of Casting Engineers, Inc., president of the Institute. A Fall meeting is scheduled for Detroit during November.

REPRESENTS SPEED-D-BURR

Industrial Materials Company, San Francisco distributors of abrasive, chemical, sanding and grinding equipment, has been appointed by Speed-D-Burr Corporation, Glendale, Calif. manufacturer of precision barrel finishing equipment, as distributors for the Bay Area, Central and Northern California.

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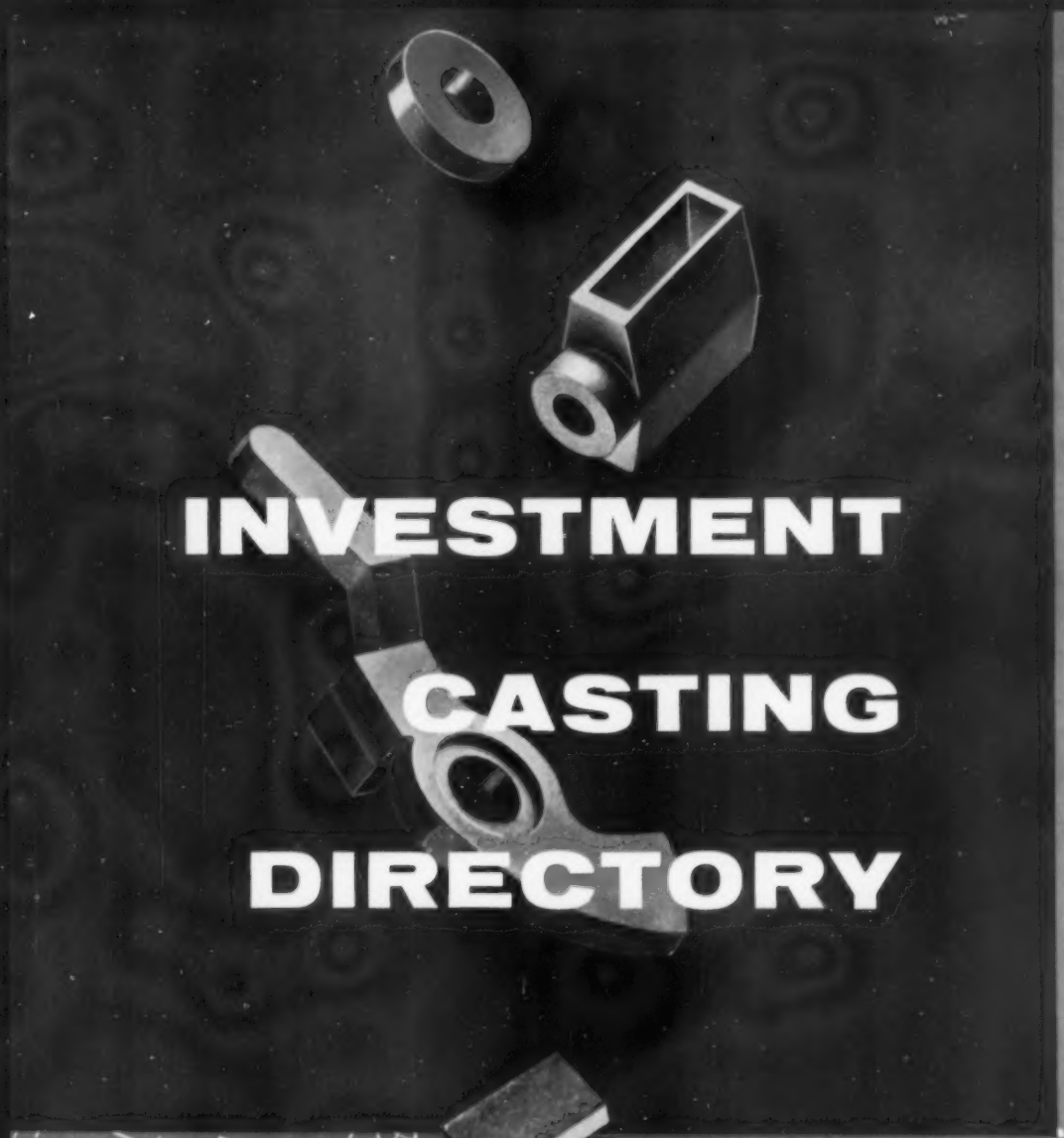
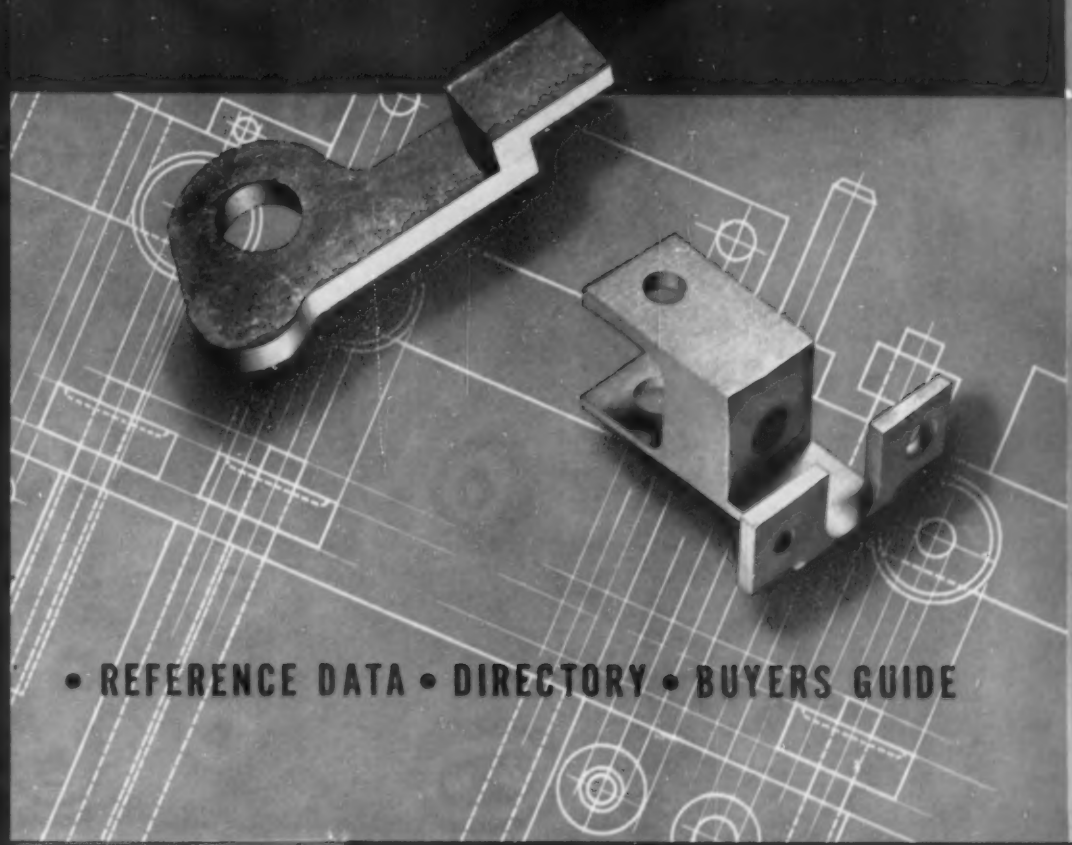


INVESTMENT CASTING DIRECTORY

FIRST ANNUAL



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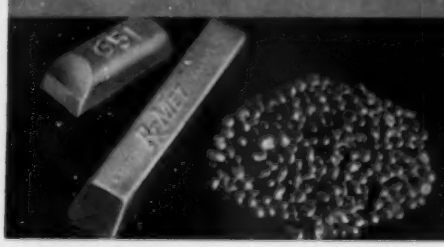

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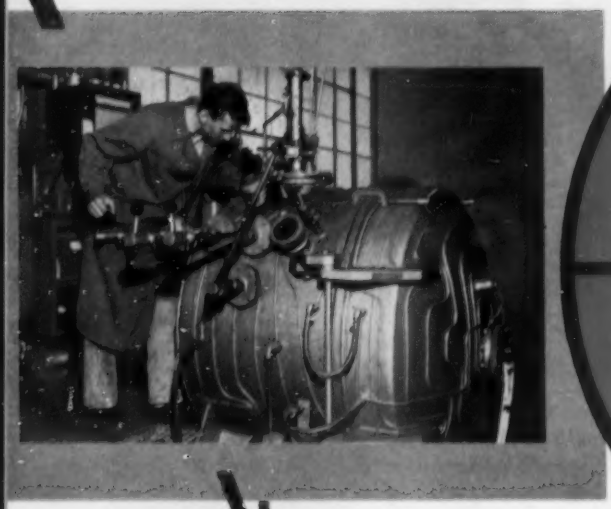
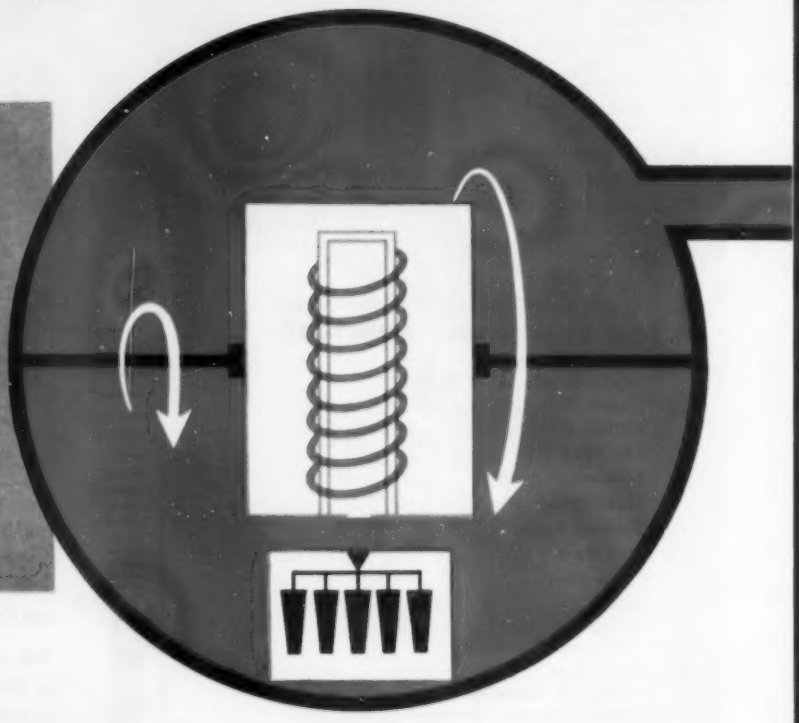




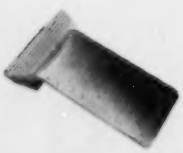
New **VACUUM MELTING** *techniques being developed by* **MICROCAST** *give promise of higher performance parts for the future*

Austenal vacuum melting and casting techniques being currently developed may have a big place in your future designs.

Vacuum melting promises greatly improved investment castings and a wider range of cast parts, because it makes available alloys with outstanding high temperature properties. By removing harmful gases and holding down objectionable oxide inclusions, vacuum melting results in parts that are more ductile, stronger and tougher than before. Vacuum melting makes possible the use of alloys that were formerly uncastable.

For instance, these new Austenal techniques are already being studied for aircraft manufacturers on a development basis. Vacuum melting has helped furnish extremely high quality vanes and blades for future jet engines.

Discuss this new Austenal development with your Austenal representative. Vacuum melting may be the way for you to obtain higher performance in designing parts for tough jobs of the future.



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TECHNICAL DATA

IN THE following pages are presented specifications for 13 investment casting alloys in seven groups, as prepared and issued by the Investment Casting Institute. In addition to the data contained under each heading, certain general specifications are applicable to all of the alloys. For purposes of simplification, these general specifications have been brought together below. These relate to the character of the melt, description of test bars, certification of tensile properties, casting quality, reports and identification. *General specs refer to all alloys, except as noted.*

It should also be pointed out that Code Number references with each alloy are from the number system of the "Cross Index of Chemically Equivalent Specifications and Identification Code" as published by the Secretary of Defense under Standardization H1-A available from the U. S. Superintendent of Documents, Washington 25, D. C.

GENERAL METAL SPECIFICATIONS

COMPOSITION

• Castings shall be poured from a remelted master heat, or directly from a master heat. A master heat is previously refined metal of a single furnace charge or blend thereof. Gates, sprues, risers, and rejected castings shall only be used in preparation of master heats. The composition of the master heat shall meet the requirements of chemical composition, and an analysis of the master heat shall be furnished with the castings on request of the customer. Where pouring is done directly from the master heat, an analysis of each heat shall be furnished on request of the customer.

• Metal in the form of shot from more than one master heat may be uniformly blended together to form a master heat lot which may be called a master heat. Total weight of metal in a master heat lot shall not exceed 10,000 pounds. (All except specification MG-1)

QUALITY

• Castings shall be uniform in quality and condition, sound and free from foreign materials and from internal and external defects detrimental to the use of the parts.

• Castings shall be produced under radiographic control only when specified by the purchaser. (Specifications AL-1, CU-1, FE-1 and FE-2 only)

• Unless otherwise specified, castings shall be produced under radiographic control (Specifications CO-1 and NI-1 only)

• Castings shall not be repaired by plugging, welding or other methods without the written permission of the purchaser.

• Inspection requirements shall be as agreed by purchaser and vendor.

REPORTS

• Report requirements must be specified in purchase order or contract. Such report shall identify each shipment by master heat number, part number and quantity.

One source of supply for ALL your investment casting needs...

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Mixing Equipment
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Cut-off Wheels
Bench Grinders
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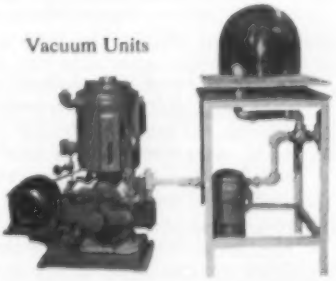
Vacuum Units



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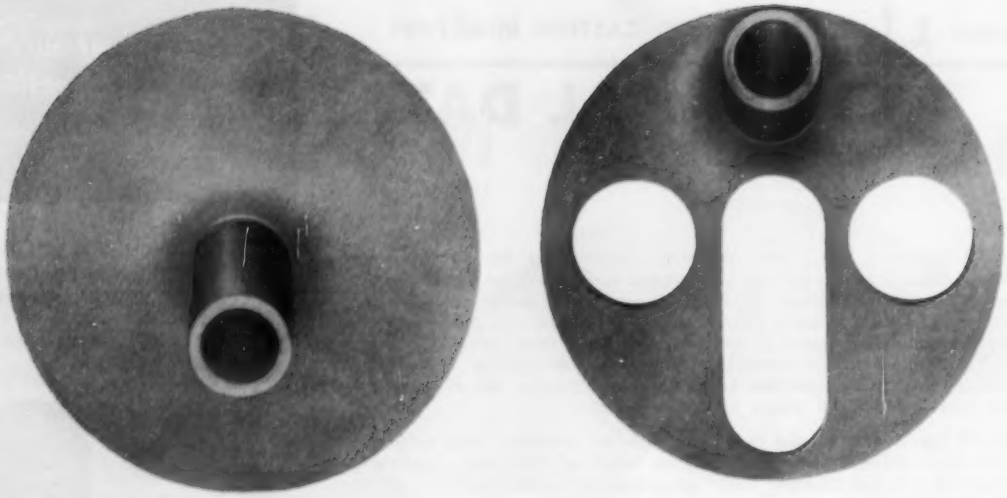

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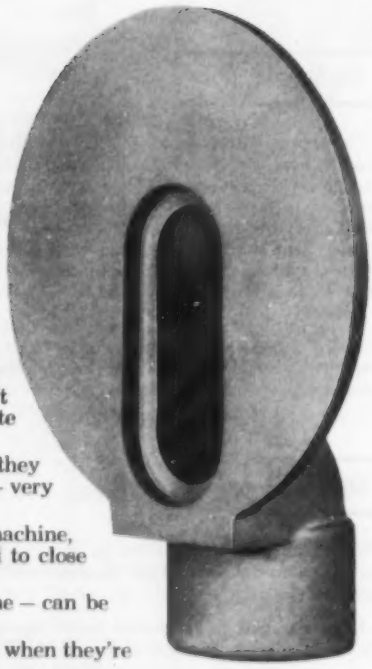

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THIN WALLS — Accurately produced by the Accumet casting process, they are impossible to make in sand or shell mold castings — very difficult to forge.

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Next time your designs call for parts with intricate shapes . . . close tolerances . . . fine finish . . . high quality and uniformity, make them Crucible Accumet castings. They are available in any grade of steel or high alloy your product calls for. Let a Crucible engineer give you all the facts about how Accumet castings can save you time and money. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

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IDENTIFICATION

• When specified, each casting or shipping container of castings shall be identified as to part number and master heat number. Methods of identification shall be as agreed upon by purchaser and vendor.

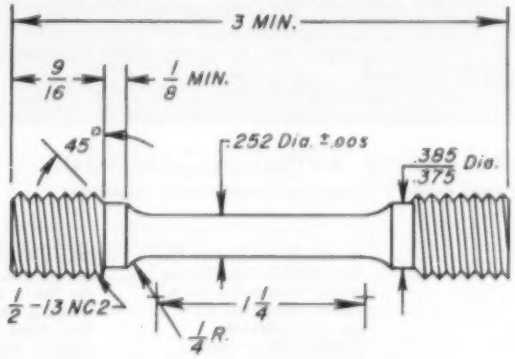
TEST BARS

• Test bars shall be of 0.25 in. nominal diameter at the reduced parallel section, shall be cast to size in molds of the same material as the molds for the castings and cooled at approximately the same rate as the castings. Metal from which the test bars are poured shall be representative of, and shall not be treated in any essential respect differently from that from which the castings are poured. See Test Bar specifications below.

• Test bars or certified statements of tensile properties shall be furnished only upon request. Such test bars will be heat treated with the castings unless otherwise specified.

• Castings are not subject to rejection for failure of test bars machined from the castings to meet the requirements shown in the pertinent Table of physical properties unless specifically agreed between customer and vendor. (Specifications AL-1, CU-1, MG-1 only)

TENSILE TEST BAR CAST-TO-SIZE



1. Test bar concentricity to be agreed upon between customer and vendor.

2. Threads may be machined but must be done in a manner to minimize stresses in the gauge length.

3. Gauge length area will be cast to size unless otherwise specified, and it is recommended the diameter of the gauge length be decreased a maximum of .003 inch at the center to facilitate mid-point fracture.

4. It is permissible to increase the .375 inch—.385 inch shoulder diameter to a maximum of .500 inch.

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Reduced machining

Whenever you need top-quality *precision made* parts that cost less to buy and use, check the many advantages of investment castings supplied by member companies of the Investment Casting Institute. As members, each company benefits from the constant exchange of information and experience and from the standards and manufacturing techniques developed and improved by cooperative effort. Through the application of these new developments, member companies can now supply all industry with better castings at much lower cost.

Members of the Investment Casting Institute are your most dependable source for better and more economical investment castings.

MANUFACTURING MEMBERS

ANDERSON, W. H., COMPANY, INC.	Detroit, Mich.
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YATES DENTAL MFG. CO.

INVESTMENT CASTING INSTITUTE

27 EAST MONROE STREET • CHICAGO 3, ILLINOIS

For more information circle No. 129 on the Reader Service Card

HEAT TREATABLE ALUMINUM ALLOY INVESTMENT CASTINGS

ICI No. AL-1

CHEMICAL COMPOSITION

GRADE	SILICON-MAGNESIUM	SILICON-COPPER
CODE NUMBER	I.C. 20356	I.C. 20355
Aluminum	Balance	Balance
Copper	0.2 Max.	1.0—1.5
Iron	0.6 Max.	0.6 Max.
Silicon	6.5—7.5	4.5—5.5
Manganese	0.3 Max.	0.3 Max.
Zinc	0.3 Max.	0.2 Max.
Magnesium	0.2—0.4	0.4—0.6
Chromium	——	CR .20 Max. PLUS 0.08—0.30** TI .20 Max.
Titanium	0.2 Max.	
Unspecified Elements*	Each 0.05 Max.	0.05 Max.
Unspecified Elements*	Total 0.15 Max.	0.15 Max.

* Analysis shall regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified in the above table.

** Chromium plus Titanium may range 0.08-0.30. If boron exceeds 0.001 per cent, chromium may be zero and titanium as low as 0.02 per cent.

HEAT TREATMENT

(a) Heat-treatments consist either of aging (T-51) or solution heat treatment followed by aging (T-6) or (T-7) as specified by the purchaser.

(b) Where no information as to type of heat treatment is given, heat treatment shall be optional with the manufacturer.

PHYSICAL PROPERTIES

CODE NUMBER	HEAT TREATED CONDITION	TENSILE STRENGTH MIN. PSI	YIELD STRENGTH (0.2% Offset) MIN. PSI	ELONGATION IN 1" MIN. PERCENT
I.C. 20356	T-51	23,000	16,000	——
I.C. 20356	T-6	30,000	20,000	3.0
I.C. 20356	T-7	30,000	——	——
I.C. 20355	T-51	25,000	——	——
I.C. 20355	T-6	32,000	20,000	2.0

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

More Metal Specs On Page 93

Reduce machining costs with top quality I.P.C. Co. investment castings—precision cast to minimize your finishing costs. I.P.C. Co. has the experience to furnish quality castings to meet large or small quantity requirements.

DESIGN

More freedom: complicated and odd shapes are easily produced.

MATERIALS

Choice of available metals ranges from non-ferrous group to carbon and high alloy steels, stainless, tool steels and special alloys—including cobalt steels.

ACCURACY

Tolerances comparable to machined parts—plus or minus .0035" per inch.

ECONOMY

Eliminates machining; permits complicated, odd-shaped designs and utilizes hard-to-machine materials.

***New home** of I.P.C. Co. is fully equipped and expertly staffed to produce fine precision investment castings.*

IPCo **ILLINOIS PRECISE CASTING CO.**

903 N. SPAULDING AVENUE • CHICAGO 51, ILLINOIS

For more information circle No. 55 on the Reader Service Card

CORROSION & HEAT RESISTANT COBALT BASE ALLOY - INVESTMENT CASTINGS

ICI No. CO-1

CHEMICAL COMPOSITION

GRADE	CHROMIUM NICKEL MOLYBDENUM	CHROMIUM NICKEL TUNGSTEN
CODE NUMBER	I.C. 13518	I.C. 13530
Carbon	0.20—0.30	0.45—0.55
Manganese	1.0 max.	1.0 max.
Silicon	1.0 max.	1.0 max.
Phosphorus	0.04 max.	0.04 max.
Sulphur	0.04 max.	0.04 max.
Chromium	25.0—29.0	24.5—26.5
Nickel	1.75—3.75	9.5—11.5
Molybdenum	5.0—6.0	—
Tungsten	—	7.0—8.0
Iron	3.0 max.	2.0 max.
Cobalt	Balance	Balance

HEAT TREATMENT

None required.

PHYSICAL PROPERTIES

High temperature tensile requirements.

CODE NUMBER	TEMPERATURE	TIME AT TEMP. Prior to Load	RATE OF STRAIN Inches/ Min.	STRENGTH PSI Min.	ELONGATION % in 4D Min. Percent
I.C. 13518	1500°F ± 10°	30 min.	0.045 — 0.062	52,000	10
I.C. 13530	1500°F ± 10°	30 min.	0.045 — 0.062	50,000	10

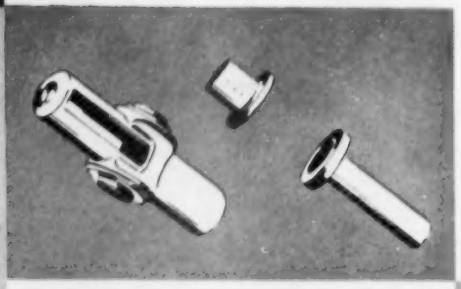
High temperature stress rupture requirements

CODE NUMBER	TEMPERATURE °F	LOAD PSI	MINIMUM RUPTURE LIFE HOURS	ELONGATION % in 4D Min. Percent
I.C. 13530	1500°F ± 10°	20,000	15	8
I.C. 13518	1500°F ± 10°	30,000	15	6

More Metal Specs On Page 95

How MIDWEST investment casting cuts costs on complex parts

This aircraft part presents an example of the improvements that can be obtained, both in cost and product, by replacing conventional manufacturing methods with Midwest's investment castings.



In the original fabrication of this component, separate parts were machined from stainless bar stock. Final assembly involved welding the individual units together to form the finished product.

advantages of midwest investment castings . . .

- **Saves Production Costs**
  By elimination of costly processes, Midwest can help you reduce costs on even the smallest, most intricate part.
- **Reduces Machining Costs**
  Smooth, accurate castings greatly reduce or eliminate machining.
- **Saves Valuable Production Time**
  Your highest production requirements are easily met by Midwest's manufacturing skill in volume runs.
- **Offers Greater Strength at No Additional Cost**
  A wide range of usable alloys permit greatest possible metallurgical variation for any specific job.
- **Faithfully Reproduces Intricate Patterns**
  Thorough quality control analyses makes certain that all work conforms to the most rigid specifications.
- **Meets Close Tolerances**
  Tolerances as close as ±.003 to .005 per inch can be held on all normal production parts.

member

Investment casting reduced costs 80%

Midwest Foundry produced the same part as an investment casting in a single operation. The process eliminated the weldment, thus delivering a better product, and at the same time reduced costs 80%.

Complete Casting Facilities Feature Modern, High-Speed Production of...

SHELL MOLD CASTING

Midwest is accustomed to running close tolerance castings in volume in grey iron and steel alloys by the shell mold process.

GREY IRON AND SEMI-STEEL CASTING

Midwest's Modern, Mechanized Grey Iron Foundry is fully equipped for high production runs.

MIDWEST OFFERS . . .
. . . a Complete Design Service

Simply outline your requirements. Our staff of expert designers will analyze your requirements and promptly suggest cost- and material-saving solutions.

Write Today for 12 page booklet outlining Midwest's complete design and production facilities.

ESTABLISHED 1854

midwest foundry company

Division of L. A. DARLING COMPANY—Coldwater, Michigan

For more information circle No. 72 on the Reader Service Card

Hardness

CODE NUMBER	AS-CAST ROCKWELL	AFTER 50 HRS. @ 1475°F ± 10° ROCKWELL
I.C. 13518	C34 max	C45 max
I.C. 13530	C34 max	C42 max

Bend testing

• *Bend Test Specimens:* When required, three specimens at least 0.090 in. in diameter or thickness and approximately 2 in. in length shall be cast in each mold along with each cast part or parts.

• Bend testing will be performed only on arc melted castings and only on the request of the purchaser. At least two of the specimens cast in each mold in accordance with 4 (d) shall withstand, without cracking, bending at room temperature, through an angle of 30 degrees around a 0.5 in. diameter. If more than one specimen from a mold fails to pass this test, the disposition of the castings from that mold may be determined by applying a similar test to an actual casting or specimens cut from castings, gates or runners. Such specimens shall be not less than 0.090 in. in diameter or thickness. Failure of any such additional specimens will be cause for rejection of the castings. If carbon is within paragraph 2 (a) for each cast cluster, bend tests are waived.

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

ICI

SILICON BRASS INVESTMENT CASTINGS

ICI No. CU-1

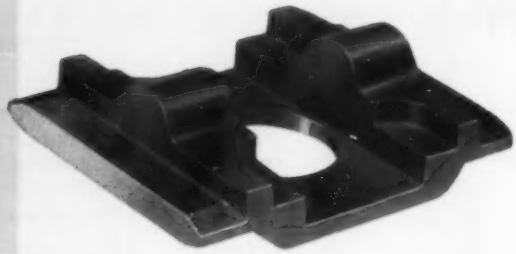
CHEMICAL COMPOSITION

ALLOY	SILICON-BRASS
CODE NUMBER	10525
Copper	Balance
Zinc	10.0—16.0
Silicon	3.0—5.0
Lead	0.5 max.
Iron	0.5 max.
Phosphorous	0.03 max.
Aluminum	0.1 max.
Others, each	0.5 max.
Unspecified elements*	1.5 max.

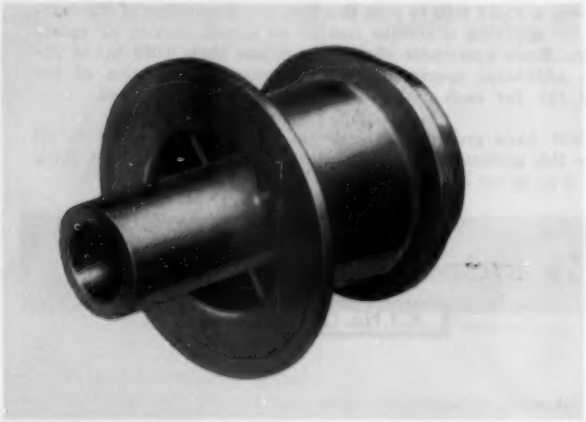
* Analysis shall regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified in the above table.

More Metal Specs On Page 97

Can you do this with INVESTMENT CASTINGS?



PRODUCTION COSTS WERE CUT 72% with this investment cast slider, even though some machining is still necessary. The part originally was machined out of solid stock. It is cast of 8630 alloy steel, which is superior to the wear-resistance of the material formerly used. Part performance, of course, has been substantially improved. Size: 2⅞" wide, 3⅞" long. Weight: 1.15 lbs.



50% Saving when One Cast Part Replaces Six Brazed Sections

Formerly made of six brazed pieces, this bearing carrier assembly is proof of the remarkable design freedom you gain with Howard's investment casting process. This is a more dimensionally accurate part because it is *one cast part.* It is considered a large investment casting, weighing 12 lbs., with a length of 8½" and a diameter of 7". The alloy is 8630 steel.

COMPARE THE EFFICIENCY OF YOUR PRESENT PRODUCTION METHODS to Howard's investment casting process. Send us your blue print or actual part. To compare favorably, we must be able to (1) eliminate enough machining to lower final costs, or (2) reduce fabrication steps by combining two or more parts into one cast part. Howard casts both ferrous and non-ferrous alloys, including high temperature steel alloys.

TWO FOUNDRY ENGINEERING CENTERS TO HELP YOU. One is located in Milwaukee and serves firms in the Mid-West and East, The West Coast is served by our Los Angeles foundry. Both plants are listed in local telephone directories and in Thomas Register of American Manufacturers. Prompt field service is supplied by Howard representatives.

World's Largest Ferrous & Non-Ferrous Special Casting Service

HOWARD
FOUNDRY COMPANY

1701 North Kostner Avenue Chicago 39 Illinois

Since 1913

Plants: Chicago • Milwaukee • Los Angeles
Unified Production Control Services: Wood and Metal Patterns • Dies • Machining
Casting by Sand Mold, Permanent Mold, Shell Mold, "Lost Wax" Investment Methods

For more information circle No. 53 on the Reader Service Card

HEAT TREATMENT

None required.

PHYSICAL PROPERTIES

TENSILE STRENGTH Min. P.S.I.	YIELD STRENGTH 0.5% Offset Min. P.S.I.	ELONGATION % in 1"
60,000	26,000	16

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

ICI

CARBON STEEL INVESTMENT CASTINGS

ICI No. FE-1

CHEMICAL COMPOSITION

GRADE	Low Carbon	Medium Carbon
CODE NUMBER	I.C. 01020	I.C. 01040
Carbon	0.15—0.25	0.35—0.45
Manganese	0.30—0.60	0.70—1.00
Silicon	0.20—1.00	0.20—1.00
Phosphorus	0.04 max.	0.04 max.
Sulfur	0.04 max.	0.04 max.
Unspecified Elements*	1.00 max.	1.00 max.

* It is recognized that unspecified elements are unavoidable in steel. In general, it may be expected that the total of unspecified elements will be less than 1.00 per cent. However, determination of these elements or certification of their limit shall be made only when specified in the order or contract.

HEAT TREATMENT

(a) All castings may receive a heat treatment proper to their design and chemical composition.

(b) The type of heat treatment, when required, shall be at the option of the manufacturer unless specified by the customer.

More Metal Specs On Page 98

(c) Heat treatment may consist of full annealing, or of normalizing, or of normalizing followed by tempering, or of annealing followed by normalizing followed by tempering. Liquid quenching followed by drawing may be used when agreed upon by manufacturer and purchaser.

PHYSICAL PROPERTIES

CODE NUMBER	CONDITION	TENSILE STRENGTH Min. PSI	YIELD STRENGTH at 0.2% Offset Min. PSI	ELONGATION in 4 D Min. Percent
I.C. 01020	Annealed	60,000	40,000	35.0
I.C. 01040	Quenched and Tempered	100,000	90,000	10.0

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

ICI

LOW ALLOY STEEL INVESTMENT CASTINGS

ICI No. FE-2

CHEMICAL COMPOSITION

GRADE	CHROMIUM MOLYBDENUM	CHROMIUM MOLYBDENUM	NICKEL CHROMIUM MOLYBDENUM
CODE NUMBER	I.C. 04130	I.C. 04140	I.C. 08730T
Carbon	0.25—0.35	0.35—0.45	0.25—0.35
Manganese	0.40—0.70	0.70—1.05	0.60—0.95
Silicon	0.20—0.80	0.20—0.80	0.20—0.80
Phosphorus	0.04 max.	0.04 max.	0.04 max.
Sulfur	0.04 max.	0.04 max.	0.04 max.
Chromium	0.80—1.10	0.80—1.15	0.35—0.65
Nickel	—	—	0.35—0.75
Molybdenum	0.15—0.25	0.15—0.25	0.15—0.30
Unspecified elements*	1.00 max.	1.00 max.	1.00 max.

* It is recognized that unspecified elements are unavoidable in steel. In general, it may be expected that the total of unspecified elements will be less than 1.00 percent. However, determination of these elements or certification of their limit shall be made only when specified in the order or contract.

HEAT TREATMENT

(a) All castings may receive a heat treatment proper to their design and chemical composition.

More Metal Specs On Page 101

Now! TOCCO* Induction Melting Furnaces for Precision Casting

One of the TOCCO Induction Melting Furnaces used at Arwood Precision Casting Co. Note TOCCO control station in background.

● Engineers at Arwood Precision Casting Co. use TOCCO Induction Melting Furnaces for melting and remelting quality steel. Other companies have found TOCCO equally adaptable for melting non-ferrous metals. No wonder! *Look at the advantages:*

- ★ Stepless power control
- ★ Extremely Rapid Melting
- ★ High Efficiency on Intermittent Operation
- ★ Good Mixing because of Natural Agitation
- ★ Extremely Low Alloy Loss
- ★ No Carbon Pick-up
- ★ No Contamination when Composition of Charges is Changed
- ★ High Reproducibility of Results
- ★ Minimum Space Requirements
- ★ No Special Installation Charge
- ★ Simple, Safe Operation
- ★ Clean, Comfortable Working Conditions

If any of these advantages suggest economies in your operations write for full details—no obligation, of course. *Mail Coupon Today*

THE OHIO CRANKSHAFT COMPANY

TOCCO

*Trade Mark Reg. U. S. Pat. Off.

NEW **FREE** BULLETIN

THE OHIO CRANKSHAFT CO.
Dept. U-6, Cleveland 5, Ohio

Please send copy of "The Case for TOCCO Induction Melting."

Name_____

Position_____

Company_____

Address_____

City_____ Zone____ State____

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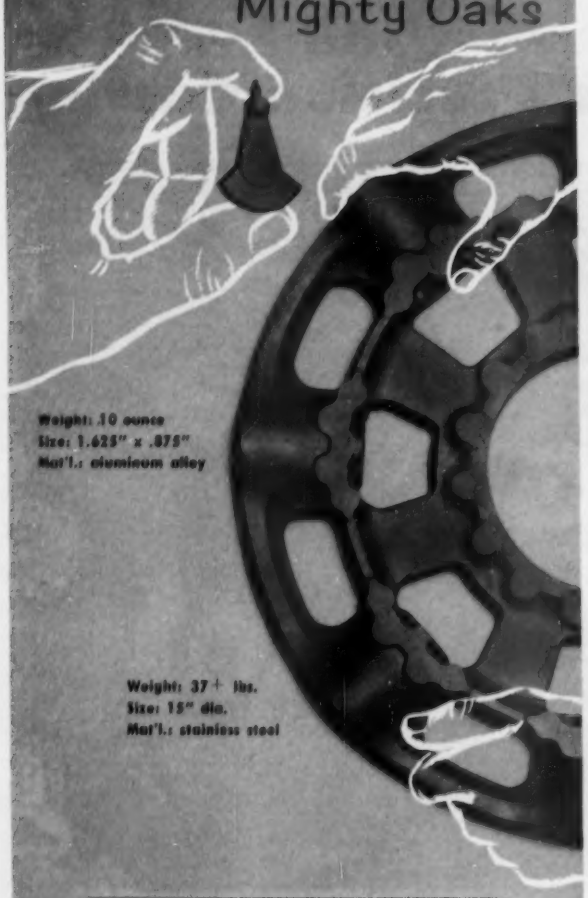
For more information circle No. 95 on the Reader Service Card

Little Acorns...or...
Mighty Oaks



FROZEN MERCURY
LOST WAX
INVESTMENT CASTINGS

Alloy Precision produces the widest range of investment casting sizes in the industry . . . large or small, thick or thin.

Alloy Precision gives you the greatest engineering and design freedom. Process and material are selected to match your part . . . your designs are not limited by a single casting technique.

Alloy Precision will produce your part in your choice of: magnesium, aluminum, copper alloys and all ferrous alloys (including stainless steel).

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A-634

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castings company
Dept. 56 • East 45th and Hamilton
Cleveland 14, Ohio

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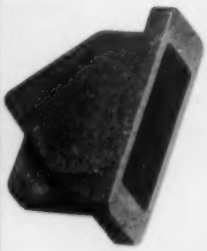
Specify Rausch
investment castings
for 3 reasons:

intricacy commands no premium nor costly fixtures and machining operations. The complexity is in the casting.



accuracy is assured, down to the smallest detail and finest surface. Rausch takes the fetters off your designers.

certification of materials is complete, guaranteeing the quality of your order. X-ray and heat-treating facilities available to meet your requirements.

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BERYLLIUM COPPER • BRASS • BRONZE • ALUMINUM ALLOYS • PRECIOUS METALS

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Prove for yourself, in your own plant, the superior quality of P-V Investment. For a sample for testing, write today telling us your requirements.

Close control at every step in our production assures you of better, more consistent workmanship. Accurate details, fine surfaces and complete filling of molds are the rule, when you make your castings in P-V Investments.

Tons of P-V Investments are used daily by leading precision casters using the expendable pattern method. Technical advice on your investing problems is available.

Prompt shipment can be made from our modern plant. And P-V Investments are *priced right!* Write, wire or phone for this sample, prices and additional information.

PRE-VEST inc.
23420 LAKELAND BLVD.
CLEVELAND 17, OHIO

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(b) The type of heat treatment when required, shall be at the option of the manufacturer unless specified by the customer.

(c) Heat treatment may consist of full annealing, or of normalizing, or of normalizing followed by tempering, or of annealing followed by normalizing followed by tempering. Liquid quenching followed by drawing may be used when agreed upon by manufacturer and purchaser.

PHYSICAL PROPERTIES

CODE NUMBER	CONDITION	TENSILE STRENGTH PSI	YIELD STRENGTH AT 0.2% OFFSET PSI	ELONGATION IN 4D MIN. PERCENT
I.C. 04130	Quenched and Tempered	120-150,000	100-130,000	10.0
I.C. 04140	Quenched and Tempered	130-160,000	110-140,000	8.0
I.C. 08730T	Quenched and Tempered	135-170,000	115-150,000	8.0

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

ICI

MAGNESIUM BASE ALLOY INVESTMENT CASTINGS

ICI No. MG-1

CHEMICAL COMPOSITION

ALLOY	ALUMINUM ZINC
CODE NUMBER	21455
Magnesium	Balance
Aluminum	8.3—9.7
Zinc	1.6—2.4
Manganese	0.10 min.
Silicon	0.3 max.
Copper	0.25 max.
Nickel	0.01 max.
Unspecified elements*	0.3 Total max.

* Analysis shall regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified in the above table.

More Metal Specs On Page 103

a new, LARGER investment casting furnace...

THE 20 LB. CAPACITY, 20 KW., ID

Detroit Electric Furnace

Phantom mold in position. Pouring is accomplished simply by inverting furnace.

Now, a direct-casting, indirect arc furnace for precision parts up to 20 pounds. The new Detroit Electric ID Furnace melts metal quickly, holds precise analysis, operates with great economy. When metal is ready, mold is clamped on and the furnace is inverted to pour the mold without further handling.

For full information on this great, new investment casting furnace, write us today.

TYPE IC, 10 LB. CAPACITY FURNACE PROVED IN 3 YEARS OF EFFICIENT PRODUCTION

Faster, better investment castings! That's the record of the IC Furnace, producing precision parts on a continuous schedule in many plants today. A high-quality production furnace!

Typical Melt Data for Type IC Furnace

Metal	Wt. Charge	Average Melt Time	K.W.H./lb. Power Consumption
Stainless Steel	6 lb.	10 min.	.364
Stoelite	5¼ lb.	9 min.	.340
Gray Iron	6 lb.	9 min.	.333
Copper	6 lb.	5 min.	.203
Yellow Brass	6 lb.	4½ min.	.179

DETROIT ELECTRIC FURNACE DIVISION

Kuhlman Electric Company • Bay City, Michigan

Foreign Representatives: in BRAZIL—Equipamentos Industrias, "Elsa" Ltd., Sao Paulo; CHILE, ARGENTINA, PERU and VENEZUELA: M. Castelli Inc., 150 Broadway, New York 7, N.Y.; MEXICO: Cia Proveedora de Industrias, Atenas 32-13, Apartado 27A3, Mexico 6, D.F., Mexico; EUROPE, ENGLAND: Birlec, Ltd., Birmingham

For more information circle No. 61 on the Reader Service Card

HEAT TREATMENT

(a) Castings shall be supplied as-cast (condition F), solution heat treated (condition T4 artificially aged only (condition T5), or solution heat treated and artificially aged (condition T6) as specified by the purchaser.

(b) Where no information as to type of heat treatment is given, treatment shall be optional with the manufacturer.

PHYSICAL PROPERTIES

CODE NUMBER	CONDITION	TENSILE STRENGTH Min. P.S.I.	YIELD STRENGTH (0.2% Offset) Min. P.S.I.
I. C. 21455	F	20,000	Not Required
"	T4	34,000	Not Required
"	T5	20,000	11,000
"	T6	34,000	18,000

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

ICI

CORROSION & HEAT RESISTANT NICKEL BASE ALLOY INVESTMENT CASTINGS

I.C.I. No. NI-1

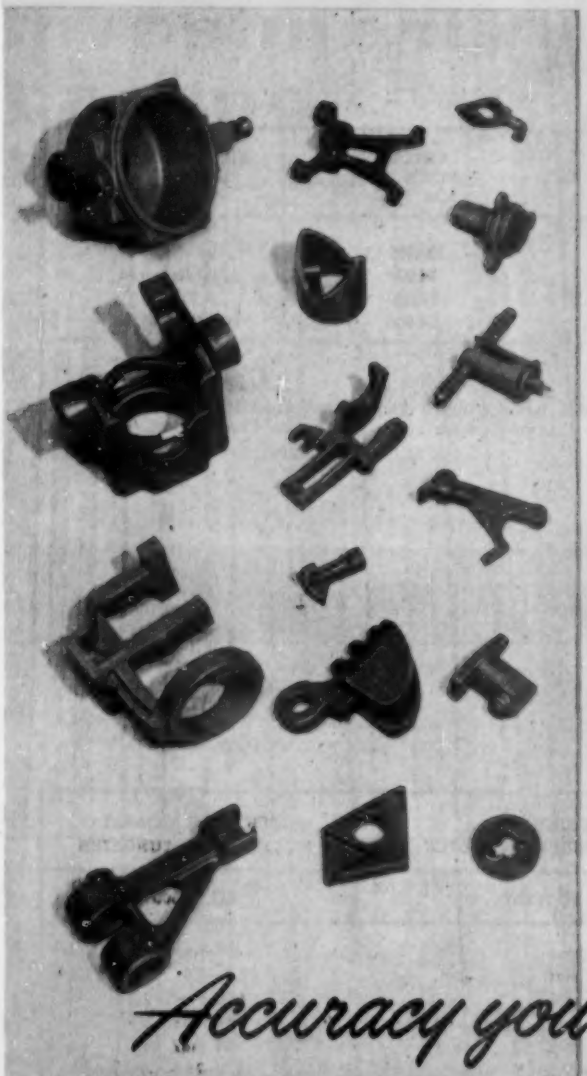
CHEMICAL COMPOSITION

GRADE	CHROMIUM MOLYBDENUM, TUNGSTEN	CHROMIUM, COBALT MOLYBDENUM, TUNGSTEN
CODE NUMBER	I.C. 13200	I.C. 13300
Carbon	.15 max	.35—.45
Manganese	1.00 max	2.0—3.0
Silicon	1.00 max	1.00 max
Phosphorus	.04 max	.04 max
Sulphur	.03 max	.03 max
Chromium	15.5—17.5	23.5—26.5
Cobalt	2.5 max (if determined)	10.0—15.0
Molybdenum	16.0—18.0	2.0—4.0
Tungsten	3.75—5.25	6.0—8.0
Iron	4.5—7.0	5.0 max
Vanadium	.20—.60	—
Nickel	Balance	Balance

More Metal Specs On Page 105

WOODWORTH'S
Single Source Service

INVESTMENT CASTINGS



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For more information circle No. 108 on the Reader Service Card

HEAT TREATMENT

None required.

PHYSICAL PROPERTIES

Room temperature tensile requirements.

CODE NUMBER	RATE OF STRAIN	TENSILE STRENGTH PSI	ELONGATION % in 1 in.
I.C. 13300	.045—.062	65,000	1% min

High temperature tensile requirements

CODE NUMBER	TEMPERATURE	TIME AT TEMP. PRIOR TO LOAD	RATE OF STRAIN Inches/Min.	STRENGTH PSI	ELONG. % in 1 in.
I.C. 13200	1500°F ± 10°	30 min.	.045—.062	50,000 min.	10% min.
I.C. 13300	1500°F ± 10°	30 min.	.045—.062	48,000 min.	6% min.

Hardness

CODE NUMBER	AS-CAST ROCKWELL	AFTER 50 HOURS @ 1475°F ± 10° Air Cooled Rockwell
I.C. 13200	C 21 max	C 42 max
I.C. 13300	C 28 max	C 32 max

Bend testing

• *Bend Test Specimens:* When required, three specimens at least 0.090 in. in diameter or thickness and approximately 2 in. in length shall be cast in each mold along with each cast part or parts.

• Bend testing of I.C. 13200 will be performed only on arc melted castings and only at the request of the purchaser. At least two of the specimens cast in each mold in accordance with 4 (d) shall withstand, without cracking, bending at room temperature, through an angle of 20 degrees around a 0.5 in. diameter. If more than one specimen from a mold fails to pass this test, the disposition of the castings from that mold may be determined by applying a similar test to an actual casting or specimens cut from castings, gates or runners. Such specimens shall be not less than 0.090 in. in diameter or thickness. Failure of any such additional specimens will be cause for rejection of the castings. If carbon is within paragraph 2 (a) for each cast cluster, bend tests are waived.

General Specifications: The editors of PMM have grouped general specifications that relate to all or several alloys beginning on page 87. See this section for specs relating to Composition, Test Bars, Quality, Reports and Identification.

Monel clamp, precision investment cast by Inco, resists corrosion and erosion in carbon packing ring assembly for Navy steam turbine. Inco precision casting cut production cost 50%.

On this clamp Inco precision casting

saves 8 operations— reduces cost 50%

Drill one hole, and this Inco precision cast Monel clamp is ready for a carbon packing ring assembly.

The assembly is made by Chas. E. Chapin Company of Rutherford, New Jersey. It seals in steam on auxiliary steam turbines for the Navy.

Originally, made by forging and machining, the clamp required eight different operations. *Inco precision casting got rid of all operations except drilling one mounting hole, cut Chapin's production cost 50%.*

Where can you save with Inco precision casting?

Do you have a part which is 6 inches by 5 inches or smaller? Does it weigh under 3 pounds? Require starting tolerances as close as plus or minus .005 inch per linear inch? And need 5 or more fabrication steps? If so, there's a good chance you can cut cost and improve design by having the part precision investment cast by Inco.

Inco precision casts most high-melting point alloys from carbon steel to the new super alloys.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

5 Advantages of INCO Precision Casting

- Save up to 60% of production costs.
- Longer life with harder alloys.
- Little or no machining required.
- Wider design latitude.
- Higher alloys at lower cost.

Get This Helpful New Booklet

Trying to keep costs in line on some small part? Then write for new 16-page booklet, "Cast to Outlast." Contains many case histories detailing how others cut costs with Inco precision casting. There is a good chance this helpful data will suggest a practical way to cut your costs, too.

INCO TRADE MARK

Inco Castings

Precision · Sand · Centrifugal

For more information circle No. 57 on the Reader Service Card

PRODUCT DIRECTORY

INVESTMENT CASTINGS

Aluminum Alloys

Advanced Jewelry Casting Co.
All Alloy Precision Casting Co.
All-Metals Precision Casting Corp.
Alloy Precision Castings Co.
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Arwood Precision Casting Corp.
Bone Engineering Corp.
Brace, Inc.
British Industries Corp. (Shaw Process Dev. Corp.) (experimental only)
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Investment Casting Co. (Pa.)
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W. O. Larson Foundry Co., The
Lawrence Laboratory
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Lynn Casting Corp.
M & M Precision Casting, Inc.
John H. Martin
Mercast Mfg. Corp.
Midwest Precision Castings Co.
Midwest Specialty Co.
National Precision Casting Corp.
Northern Precision Casting Co., Inc.
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Paramount Precision Casting Co.
Perfect Casting
Perficast, Inc.
Picco, Inc.
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Precision-Cast Products Co.
Precision Metal Products, Inc.
Precision Metalsmiths, Inc.
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Scientech Co.
Scott Casting & Mfg. Corp.
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Tectron, Inc.
K. W. Thompson Tool Co.
United States Castings, Inc.
Universal Castings Corp., Inc.
Wade Mfg. Corp.
Westinghouse Electric Corp. Blairsville Metals Plant
Whip-Mix Corp.
Witkin Precision Castings
N. A. Woodworth Co.
York Castings, Inc.
Z & H Mfg. Corp.
Zenith Precision Casting Co., Inc.

Cobalt Alloys

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Crucible Steel Co. of America
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National Precision Casting Corp.
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Perfect Casting
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Precision Metal Products, Inc.
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Tectron, Inc.
United States Castings, Inc.
Westinghouse Electric Corp. Blairsville Metals Plant
Whip-Mix Corp.
York Castings, Inc.

Copper Alloys

Advanced Jewelry Casting Co.
All-Metals Precision Casting Corp.
Alloy Precision Castings Co.
W. H. Anderson Co., Inc.
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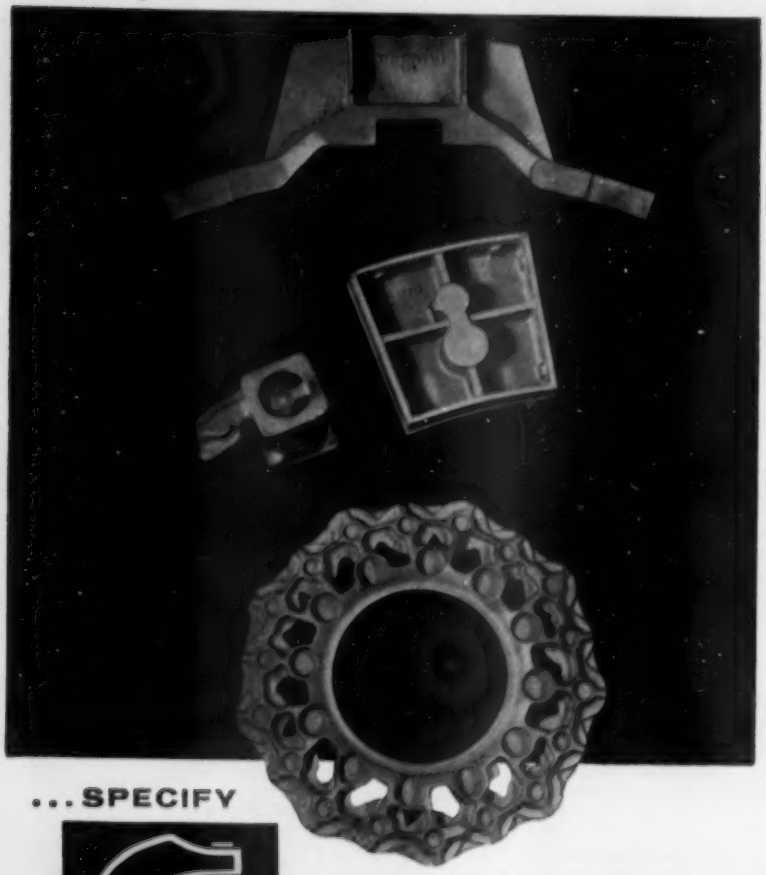
Frankel Co., Inc.

WHEN **STEEL CASTINGS** MUST BE
INTRICATE ... in design
ACCURATE ... in finish
MODERATE ... in cost



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LEBANON'S NEW CASTING PROCESS

... **ceramicast**—Lebanon's new casting process—has opened up new horizons for the design engineer working with ferrous alloys. The unique qualities of precision castings are substantially retained, yet at greatly reduced costs. The process answers a critical need by supplementing other steel casting methods and enabling greater versatility of design than ever before.

... **our services to you:** Let us show you how the Ceramicast Process is adaptable to your project design. Send us your blueprints or visit our plant in Lebanon.

WRITE FOR CERAMICAST LITERATURE:
4 page brochure describing process; case histories of two aircraft steel castings now in quantity production.

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CIRCLE L

LEBANON STEEL FOUNDRY
168 LEHMAN STREET LEBANON, PENNSYLVANIA
CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

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Low Alloy Steel

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Austenal Laboratories, Inc. Microcast Div.
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And now we are all set up to provide you with zinc die castings which combine more than half a century of experience with the vision of the future. Here we have every modern facility to produce castings which excel in design, appearance, performance and strength. We would like to tell you how our set-up fits into **your** needs.

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investment
castings

PAY
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You save considerable time, trouble, and expense when Scott investment casts your ferrous or non-ferrous parts.

Time, because Scott experience speeds the entire process of designing the part for casting. Scott specialists work with you right through from start to finish.

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Further, as a Division of Rolle Manufacturing Company, Scott can offer you the most complete laboratory test and quality control facilities.

WRITE NOW for complete information on Scott's facilities for increasing your dividends on investment casting.

SCOTT
CASTINGS

DIVISION OF ROLLE
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Cannon Avenue,
Lansdale, Pa.

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High Vacuum Investment Casting

with NRC Vacuum Furnace Model No. 2553 at Austenal Laboratories, Microcast Div., Dover, N. J.

Here's How to get Your Share of Investment Casting's Newest Market

Progressive investment casters have demonstrated — with small NRC Vacuum Furnaces like the one above — that there is a growing demand for vacuum investment castings. Their findings have already resulted in orders for production-sized furnaces.

Vacuum investment casting yields products with greater strength and fatigue characteristics, improved impact resistance, extreme cleanliness, and exact alloy composition. These properties are in demand by the aircraft and other industries who are searching for materials which will improve the performance of their products.

It's not yet too late for you to get your share of this new market. Take advantage of the experience we have gained in building and operating more vacuum furnaces than any other manufacturer in the world. Whether you want to develop your own process on a pilot scale, or move directly into production, you can get a standard NRC Vacuum Investment Casting Furnace exactly suited to your needs. Send coupon for further facts.

NRC high vacuum products include: dehydrators, freeze driers, gas analyzers, impregnators, gauges, metallizers, pumps, valves, vacuum furnaces.

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Address.....
City..... Zone..... State.....

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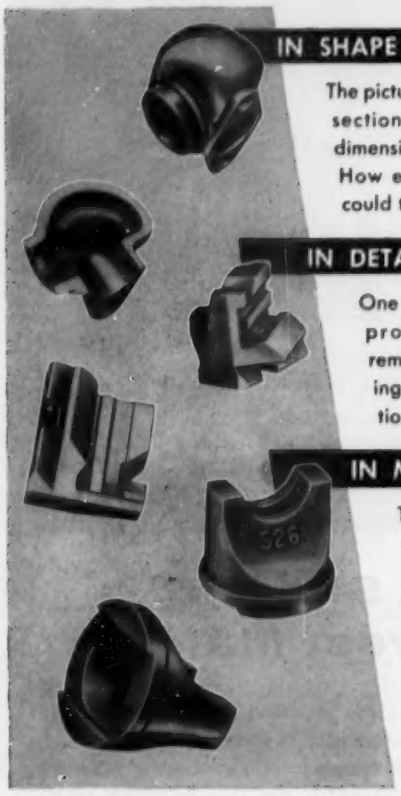
HERE'S HOW...

INVESTMENT CASTING ANSWERS DESIGN PROBLEMS

Investment Casting is a specific production method that fills a specific function. This process offers much greater latitude in shape, detail reproduction and choice of alloy than any other process.



IN SHAPE

The picture tells the story . . . from the cross section it can be seen that the inside dimensions are greater than the holes. How else but by Investment Casting could this be made in one piece?

IN DETAIL REPRODUCTION

One look quickly shows the machining problems — most of them stock removal. By using an Investment Casting 21 out of 45 machining operations were eliminated.

IN MATERIAL

These nozzles for a highway striping paint sprayer, were produced from cold rolled steel until ground glass was introduced into the paint for its reflective properties. To provide necessary wear resistance these parts are now cast in a non-machinable alloy. Performance was not sacrificed because of material limitations.

These are a few examples demonstrating that the function of the part is the first consideration in design — and — the Investment Casting process was the economical answer.

For more information ask for our brochure . . . its FREE of course.

HITCHINER
Manufacturing Company
MILFORD 7, NEW HAMPSHIRE
REPRESENTATIVES IN PRINCIPAL CITIES

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Kolcast Industries, Inc.
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Precision Metalsmiths, Inc.
Frank Roth Co., Inc.
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Shields & Co.
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K. W. Thompson Tool Co.
United States Castings, Inc.
Universal Castings Corp., Inc.
Westinghouse Electric Corp.
Blairsville Metals Plant
Whip-Mix Corp.
Witkin Precision Castings
N. A. Woodworth Co.
York Castings, Inc.

Stainless Steel

All-Metals Precision Casting Corp.
Alloy Precision Castings Co.
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Arwood Precision Casting Corp.
Austenal Laboratories, Inc.
Microcast Div.
R. W. Biggs & Co., Inc.
Div. Hamilton Watch Co.
Bone Engineering Corp.
British Industries Corp.
(Shaw Process Dev. Corp.)
(experimental only)
Brace, Inc.
British Industries Corp.

(Shaw Process Dev. Corp.)
(experimental only)
Cadmet Corp.
California Precision Castings, Inc.
Casting Engineers, Inc.
Crestline Products, Inc.
Crucible Steel Co. of America
Dean Precision Castings, Inc.
Deloro Stellite
Duncan-Rhone & Co.
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General Electric Co.
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Harcast Co.
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Intricast, Inc.
Investment Casting Co. (N. J.)
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Jelrus Precision Casting Co., Inc.
Joseff
Kolcast Industries, Inc.
Liebros Casting Co., Inc.
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Precision Metalsmiths, Inc.
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Standard Tool Co.
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Tectron, Inc.
K. W. Thompson Tool Co.
United States Castings, Inc.
Westinghouse Electric Corp.
Blairsville Metals Plant
Whip-Mix Corp.
Witkin Precision Castings
N. A. Woodworth Co.
York Castings, Inc.
Zenith Precision Casting Co., Inc.

Tool Steel

All-Metals Precision Casting Corp.
Alloy Precision Castings Co.
W. H. Anderson Co., Inc.
Arwood Precision Casting Corp.
Austenal Laboratories, Inc.
Microcast Div.
Bone Engineering Corp.
British Industries Corp.
(Shaw Process Dev. Corp.)
(experimental only)
Cadmet Corp.
California Precision Castings, Inc.
Casting Engineers, Inc.
Crestline Products, Inc.
Crucible Steel Co. of America
Dean Precision Castings, Inc.
Deloro Stellite
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General Electric Co.
Gowin & Keleher Investment Casting Co.
Gray-Syracuse, Inc.
Harcast Co.
Hitchiner Mfg. Co., Inc.
Howard Foundry Co.
Investment Casting Div.
Illinois Precise Casting Co.
Industrial Casting Corp.
Industrial Fine Castings Ltd.
International Nickel Co., Inc., The
Intricast, Inc.
Investment Casting Co. (N. J.)
Investment Casting Co. (Pa.)
Jelrus Precision Casting Co., Inc.
Joseff

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Custom made and quality controlled
to your specifications and requirements

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in our own variable pressure production type injection machine using precision molds designed to determine such characteristics as shrinkage, surface, internal stresses and setting time

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MAmaroneck 9-4746 — Cable: Margueso

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2 | PRODUCTS: **CASTINGS**

Tool Steel—continued

Kolcast Industries, Inc.
Liebros Casting Co., Inc.
M & M Precision Casting, Inc.
Mercast Mfg. Corp.
Midwest Foundry Co.
(A Div. of L. A. Darling)
Midwest Precision Castings Co.
Misco Precision Casting Co.
National Precision Casting Corp.
Northern Precision Casting Co., Inc.
Omni-Metal Castings, Inc.
Paramount Precision Casting Co.
Perfect Casting
Picco, Inc.
Precision Cast Parts Co.
Precision Metal Products, Inc.
Precision Metalsmiths, Inc.
Frank Roth Co., Inc.
Scott Casting & Mfg. Corp.
Standard Tool Co.
Supreme Precision Castings Ltd.
Tectron, Inc.
K. W. Thompson Tool Co.
United States Castings, Inc.
Westinghouse Electric Corp.
Blairsville Metals Plant
Whip-Mix Corp.
Witkin Precision Castings
N. A. Woodworth Co.
York Castings, Inc.
Zenith Precision Casting Co., Inc.

Others

Advanced Jewelry Casting Co. (sterling)
All Alloy Precision Casting Co. (zinc)
R. W. Biggs & Co., Inc. Div. Hamilton Watch Co. (precious metals)
Budd-Stanley Co., Inc. (pure copper)
Crucible Steel Co. of America (Alnico)
Deloro Stellite (Alnico)
Duncan-Rhone & Co. (electro-magnetic alloys)
Gray-Syracuse, Inc. (zinc)
Howard Foundry Co. Investment Casting Div. (titanium)
Investment Casting Co. (N. J.) (magnetic iron)
W. O. Larson Foundry Co., The (C-iron, ductile iron)
Lynn Casting Corp. (barium)
John H. Martin (precious metals)
Precision-Cast Products Co. (industrial silver)
Scientech Co. (precious metals)
Scott Casting & Mfg. Corp. (nitralloy)
L. E. Simmons Refining Co. (precious metals)
Tectron, Inc. (Stellite 21)
N. A. Woodworth Co. (Stellites)
Zenith Precision Casting Co., Inc. (precious metals)

MATERIALS

Crucibles

American Refractories & Crucible Corp.
Joseph Dixon Crucible Co.
Electro Refractories & Abrasives Co.
Harbison-Walker Refractories Co.
Lava Crucible-Refractories Co.
Lepel High Frequency Laboratories, Inc.
Ross-Tacony Crucible Co.
Vesuvius Crucible Co.

Investment Binders

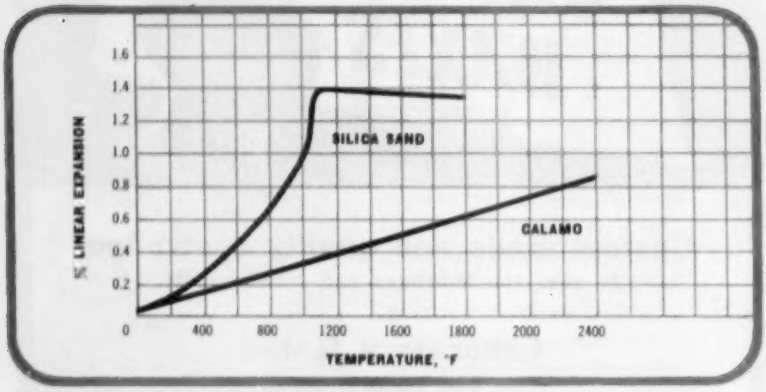
Anderson Chemical Co., Inc. (ethyl silicate, ethyl alcohol)
Carbide & Carbon Chemicals Co. (ethyl silicate, ethyl alcohol)
R. W. Greeff & Co., Inc. (ethyl silicate)
Kerr Mfg. Co. (silicate)
National Aluminate Corp. (silica sol—aqueous)
National Casting Products, Inc.
Ransom & Randolph Co., The (phosphate)
Riches-Nelson, Inc. (silicate)

HARBISON-WALKER

REFRACTORY

Mold Materials

for precision metal casting



CALAMO, one of the extensively used Harbison-Walker products for investment molding is an alumina-silica refractory of optimum sizings for particular mixtures. Its fusion point is 100°F higher than that of normal silica sand mixes.

The chart above shows the exceedingly desirable expansion curve of CALAMO as compared with that of silica sand. CALAMO used as the major constituent of investment mixes, improves the dimensional uniformity of the molds and makes them stronger and more resistant to erosion.

H-W MOLDSAND BOND is a highly refractory clay having unusual plasticity and bonding strength. Used alone or with other binders, it imparts enhanced hot strength. It is used with equally good results in sand and calamo mixes.

Please write us for information regarding other Harbison-Walker products—mold wash materials—ceramic molding media—shell molding minerals.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Most Complete Refractories Service
GENERAL OFFICES PITTSBURGH 22, PENNSYLVANIA

For more information circle No. 20 on the Reader Service Card

Alexander Saunders & Co.
(phosphate, silicate, organic)
U. S. Stone Corp.
(water bond)
Zenith Precision Casting Co., Inc.
(phosphate)

Investment Materials

Centrifugal Casting Supply Co.
(ferrous, non-ferrous and core investments)
A. P. Green Fire Brick Co.
(grog)
Harbison-Walker Refractories Co.
(grog)
Kerr Mfg. Co.
(silica, gypsum)
National Casting Products, Inc.
Pre-Vest, Inc.
(phosphate and gypsum bonded investments)
Ransom & Randolph Co., The
(silica, gypsum)
Alexander Saunders & Co.
(silica, grog, gypsum)
Tamms Industries, Inc.
(silica)
Whip-Mix Corp.
(ferrous and non-ferrous investments)
Zenith Precision Casting Co., Inc.
(silica)
Zirconium Corp. of America
(grog)

Pattern Die Materials

Manco Products, Inc.
Cerro de Pasco Corp.
Perma-Flex Mold Co., The
Alexander Saunders & Co.
Scientech Co.

Pattern Materials: Mercury

F. W. Berk & Co., Inc.

Pattern Materials: Plastic

Bakelite Co.
A Div. of Union Carbide & Carbon Corp.
Centrifugal Casting Supply Co.
Dura Commodities Corp.
Scientech Co.

Pattern Materials: Wax

M. Argueso & Co., Inc.
Bakelite Co.
A Div. of Union Carbide & Carbon Corp.
Bareco Wax Co.
Div. of Petrolite Corp.
Centrifugal Casting Supply Co.
Dura Commodities Corp.
Kerr Mfg. Co.
Ransom & Randolph Co., The
Alexander Saunders & Co.
J. Yates Dental Mfg. Co.

Parting Compounds & Mold Washes

Harbison-Walker Refractories Co.

EQUIPMENT

Casting Clean-Up Equipment

Alexander Saunders & Co.
(abrasive belts, abrasive blast, barrel tumbling, cut-off wheels)
British Industries Corp.
Pangborn Corp.
(abrasive blast)

Casting Equipment:

Centrifugal

Centrifugal Casting Supply Co.
Kerr Mfg. Co.
Alexander Saunders & Co.

Casting Equipment: Gravity

Alexander Saunders & Co.

Casting Equipment: Vacuum

Centrifugal Casting Supply Co.
Lepel High Frequency Laboratories, Inc.
National Research Corp.
Optical Film Engineering Co.
Alexander Saunders & Co.
F. J. Stokes Machine Co.

Furnace Refractories

Kuhlman Electric Co.
Detroit Electric Furnace Div.
Harbison-Walker Refractories Co.

Furnaces: Burnout

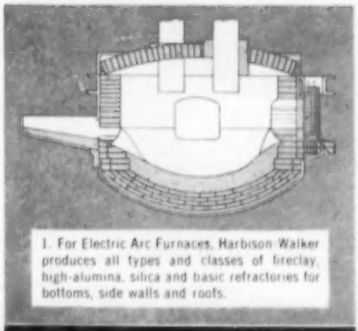
Alexander Saunders & Co.
British Industries Corp.

Furnaces: Melting Carbon Arc

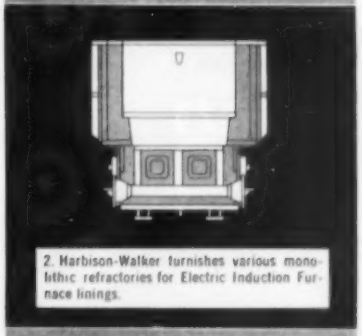
Kuhlman Electric Co.
Detroit Electric Furnace Div.
Alexander Saunders & Co.

HARBISON-WALKER

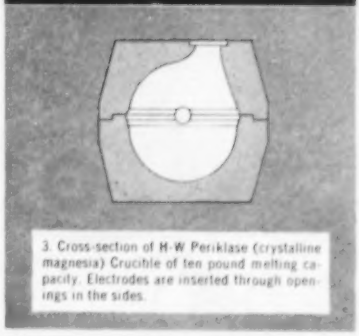
REFRACTORIES



1. For Electric Arc Furnaces, Harbison-Walker produces all types and classes of fireclay, high-alumina, silica and basic refractories for bottoms, side walls and roofs.



2. Harbison-Walker furnishes various monolithic refractories for Electric Induction Furnace linings.



3. Cross-section of H-W Periklase (crystalline magnesia) Crucible of ten pound melting capacity. Electrodes are inserted through openings in the sides.

meet every melting furnace requirement

AMONG the many kinds of refractories made by Harbison-Walker for all the different types of electric induction, arc and resistance furnaces and for the wide variety of metals, are some particularly adapted for highly specialized requirements.

H-W CORUNDUM is the 99+% Alumina preformed refractory used in linings of furnaces for melting pure aluminum, free from contaminants.

H-W PERIKLASE melting crucibles are the accepted standard for many precision metal molding operations.

We will be glad to provide complete data for these and other Harbison-Walker refractories, especially suited for melting furnaces.

HARBISON-WALKER REFRACTORIES COMPANY
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INVESTMENT CASTING IS ECONOMICAL IF...

- **Performance requirements demand use of alloys that are difficult to form or machine.**
- **Intricate shape or unusual contours cause expensive machining, finishing, and/or assembly costs.**
- **Production runs too small to warrant machine set-ups.**
- **Part sizes are smaller than 10" or lighter than 10 pounds.**
- **Realistic tolerances and inspection standards are specified.**

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LIGHTER, STRONGER, CHEAPER

Stainless steel hinge for military ordnance component was formerly composed of a stamped bracket and machined hinge, welded together and assembled to a complicated anti-rotation device. Entire unit is now cast in one piece and is lighter and stronger. Hole-reaming is only machining required.

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Alexander Saunders & Co.
Surface Combustion Corp.

Melting Furnaces—Induction
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Inductotherm Corp.
Lepel High Frequency Laboratories, Inc.
Ohio Crankshaft Co. Tocco Div.
Alexander Saunders & Co.
Zirconium Corp. of America

Pattern Equipment: Flasks
Centrifugal Casting Supply Co.
Alexander Saunders & Co.

Plastic Molding Presses
Reed-Prentice Corp.
Alexander Saunders & Co.
Standard Tool Co.
F. J. Stokes Machine Co.
Van Dorn Iron Works Co., The

Wax Injectors
All-Metals Precision Casting Corp.
Centrifugal Casting Supply Co.
Alexander Saunders & Co.

Wax Melters
Alexander Saunders & Co.
Sta-Warm Electric Co.

Vacuum Equipment: Investment De-Airing
Optical Film Engineering Co.
Alexander Saunders & Co.
F. J. Stokes Machine Co.

Vacuum Equipment: Metal Degassing
Lepel High Frequency Laboratories, Inc.
National Research Corp.
Optical Film Engineering Co.
Alexander Saunders & Co.
F. J. Stokes Machine Co.

Vacuum Equipment: Melting
Lepel High Frequency Laboratories, Inc.
National Research Corp.
Optical Film Engineering Co.
Alexander Saunders & Co.
F. J. Stokes Machine Co.

METALS AND ALLOYS
(I-B-S—Ingot, Bar, Shot)

Aluminum Alloys
Aluminum Smelting & Refining Co.
American Smelting & Refining Co., Federated Metals Div.
Apex Smelting Co. (I)
Belmont Smelting & Refining Works (I)
Beryllium Corp., The (beryllium aluminum)
Brush Beryllium Co. (beryllium aluminum)

H. Cohn & Sons, Inc. (I)
Samuel Greenfield Co., Inc. (I)
George Sall Metals Co., Inc. (I)
U. S. Reduction Co. (I)

Cobalt Alloys

Brush Beryllium Co., The (I-B-S)
(beryllium cobalt)
Cannon-Muskegon Corp. (I-B-S)
(AMS 5382, 5385, 5388, etc.)
Crucible Steel Co. of America (B-S)
(Crucast X-40, Crucast VT)
Deloro Stellite (I-B-S)
(Stellite, AMS 5382 B and 5385 B)
Frankel Co., Inc. (I-B-S)
General Electric Co. (I)
Haynes Stellite Co.
A Div. of Union Carbide & Carbon Corp. (I-S)
(Haynes Stellite alloys 3, 6, 21, 31; Haynes alloy 25)
Kolcast Industries, Inc. (I)
WaiMet Alloys Co. (I-B-S)

Copper Alloys

Beryllium Corp., The
(beryllium copper)
Brush Beryllium Co., The (I-B-S)
(beryllium copper)
Penn Precision Products, Inc. (I-S)
(beryllium copper)
Shields & Co. (S)

Low Alloy Steels

Cannon-Muskegon Corp. (I-B-S)
(4130, 8620, 1020)
General Electric Co. (I)

how Ajax
induction
melting
meets investment
casting
requirements
. . . at Precision Metalsmiths, Inc.
The special melting requirements of precision investment casting are an old story to Precision Metalsmiths, Inc., Cleveland, Ohio. This one foundry melts ninety-two different ferrous and nonferrous alloys . . . often in small quantities. Many of these alloys require unusual protection from contamination during melting—and substantially all are made to extremely close analyses. Carbon content in some must be kept below .04%.
Only an Ajax-Northrup converter-powered induction melting unit could meet the requirements of versatility, purity, and economy so well. That's why four Ajax units now satisfy all the company's production needs. Three 17 pound capacity portable furnaces are each powered by 20 kw Ajax-Northrup spark gap converters; and the fourth, a fifty pound capacity tilting furnace, is powered by a 40 kw Ajax-Northrup converter.
Precision Metalsmiths standardized on Ajax because Ajax-Northrup units cost far less to operate and maintain in operation. They're ruggedly constructed to take the toughest kind of service in stride. Normal converter maintenance is limited to cleaning the gap chamber and inspection at three month intervals. For additional details, write Ajax Electrothermic Corp., Trenton 5, New Jersey, requesting Bulletins 14-B and 27-B.
Associated Companies: Ajax Electric Company—Ajax Electric Furnace Co.—Ajax Engineering Corp.
AJAX NORTHRUP
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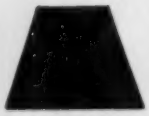
18 sizes
(⅛" to 2")

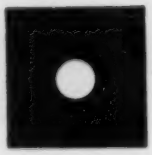


WEDGES
4 sizes
(⅛" to 5/16")

RECTANGLES
7 sizes
(¼" to 1⅛")

TRIANGLES
2 sizes
(1" & 1¼")

HALF-ROUNDS, SEGMENTS
8 sizes
(½" to 1¼")



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17 sizes
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Nickel Alloys

Beryllium Corp. The (beryllium nickel)
Brush Beryllium Co., The (I-B-S) (beryllium nickel)
Cannon-Muskegon Corp. (I-B-S) (Inconel, Monel, high temperature types)
Crucible Steel Co. of America (B-S) (PW-651, Crucast HC)
Frankel Co., Inc. (I-B-S)
General Electric Co. (I)
Haynes Stellite Co.
A Div. of Union Carbide & Carbon Co. (I-S)
(Hastelloy alloys B, C, X; Thet alloy)
International Nickel Co., Inc., The (S) (nickel)
Kolcast Industries, Inc. (I)
Shields & Co. (S)
WaiMet Alloys Co. (I-B-S)

Stainless Steels

Armco Steel Corp. (I-B)
(all standard grades and Armco 17-4 PH)
Cannon-Muskegon Corp. (I-B-S) (300 and 400 series, Armco 17-4 PH)
Crucible Steel Co. of America (B-S) (302, 303, 304, 309, 310, 316, 330, 347, 410, 430, 440-C)
Charles Dreifus Co. (B)
Frankel Co., Inc. (I-B-S)
General Electric Co. (I)
Kolcast Industries, Inc. (I)
WaiMet Alloys Co. (I-B-S)

Tool Steels

Cannon-Muskegon Corp. (I-B-S) (SAE, AISI, T1, M2, etc.)
Crucible Steel Co. of America (B-S) (Ketos, Air Kool, Airdi 150, Hyco, Halcomb 218, Airdi 300, Peerless A, NuDie V)
Frankel Co., Inc. (I-B-S) (18-4-1, 6-6-2)
General Electric Co. (I)
WaiMet Alloys Co. (I-B-S)

Others

Beryllium Corp., The (ferro-beryllium, beryllium metal)
Deloro Stellite (I-B-S) (Alnico)
Shields & Co. (precious metals)
L. E. Simmons Refining Co. (I-B-S)
WaiMet Alloys Co. (I-B-S) (super-stainless alloys and carbon steels)

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ON REQUEST—We will be glad to send our brochure and all other data to help you with your special casting problems.

WRITE TO DEPT. A

For more information circle No. 58 on the Reader Service Card

ALPHABETICAL DIRECTORY

INVESTMENT CASTINGS

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21 W. 30
New York, N. Y.
(investment castings)

All Alloy Precision Casting Co.
118 Sheldon Ave., S.E.
Grand Rapids, Mich.
(investment castings)

All-Metals Precision Casting Corp.
18 School
Yonkers, N. Y.
(investment castings, pattern materials and equipment)

Alloy Precision Castings Co.
E. 45 St. & Hamilton Ave.
Cleveland, O.
(investment castings)

W. H. Anderson Co., Inc.
21250 W. Eight Mile Rd.
Detroit, Mich.
(investment castings)

Arwood Precision Casting Corp.
70 Washington
Brooklyn, N. Y.
(investment castings)

Austenal Laboratories, Inc.
Microcast Div.
224 E. 39
New York, N. Y.
(investment castings)

R. W. Biggs & Co., Inc.
Div. Hamilton Watch Co.
174 Richmond Hill Ave.
Stamford, Conn.
(investment castings)

Bone Engineering Corp.
701 W. Broadway
Glendale, Cal.
(investment castings)

Brace, Inc.
6237 Penn Ave., S.
Minneapolis, Minn.
(investment castings)

British Industries Corp.
(Shaw Process Dev. Corp.)
80 Shore Rd.
Port Washington, N. Y.
(investment castings; melting burnout and casting clean-up equipment)

Budd-Stanley Co., Inc.
43-01 22nd Street
Long Island City, N. Y.
(investment castings)

Cadmet Corp.
20801 Ryan Rd.
Detroit, Mich.
(investment castings)

California Precision Castings, Inc.
1721 Standard Ave.
Glendale, Cal.
(investment castings)

Casting Engineers, Inc.
2323 N. Bosworth Ave.
Chicago, Ill.
(investment castings)

Centrifugal Casting Co.
147 W. 42
New York, N. Y.
(investment castings)

Crestline Products, Inc.
218 N. Fifth
Minneapolis, Minn.
(investment castings)

Crucible Steel Co. of America
1000 S. 4
Harrison, N. J.
(investment castings, tool steels, stainless steels, nickel alloys, cobalt alloys)

Dean Precision Castings, Inc.
2831 Second Ave., S.
Minneapolis, Minn.
(investment castings)

Deloro Stellite
Kingston Rd.
Belleville, Ontario, Canada
(investment castings, cobalt alloys)

Duncan-Rhone & Co.
11310 Sherman Way
N. Hollywood, Cal.
(investment castings)

Econocast Corp.
New Albany Rd.
Moorestown, N. J.
(investment castings)

Electronicast
(Div. of Nilsen Mfg. Co.)
25 N. Church
Addison, Ill.
(investment castings)

Engineered Precision Casting Co.
P. O. Box 68
Matawan, N. J.
(investment castings)

F-R Machine Works, Inc.
26-12 Borough Place
Woodside, N. Y.
(investment castings)

Fallon Industries
17695 Filer
Detroit, Mich.
(investment castings)

Ferro Cast Corp.
1301 Olympic Blvd.
Santa Monica, Cal.
(investment castings)

Frankel Co., Inc.
19300 Filer Ave.
Detroit, Mich.
(investment castings, tool steels, stainless steels, nickel alloys, cobalt alloys)

General Electric Co.
1 River Rd.
Schenectady, N. Y.
(investment castings, low alloy steels, tool steels, stainless steels, nickel alloys, cobalt alloys)

Gowin & Keleher Investment Casting Co.
82-88 Center
Middletown, Conn.
(investment castings)

Gray-Syracuse, Inc.
West Seneca Street
Manlius, N. Y.
(investment castings)

Hampshire Casting Co.
11 Davis
Easthampton, Mass.
(investment castings)

Harcast Co.
620 E. Glenolden Ave.
Glenolden, Pa.
(investment castings)

Haynes Stellite Co.
A Div. of Union Carbide & Carbon Corp.
725 S. Lindsay
Kokomo, Ind.
(investment castings, nickel alloys, cobalt alloys)

Hitchiner Mfg. Co., Inc.
P. O. Box 232
Milford, N. H.
(investment castings)

Howard Foundry Co.
Investment Casting Div.
5100 N. 33
Milwaukee, Wis.
(investment castings)

Humphrey Castings, Inc.
2815 Canon
San Diego, Cal.
(investment castings)

Illinois Precise Casting Co.
613 W. 16
Chicago, Ill.
(investment castings)

Industrial Casting Corp.
1347 8th Street
Berkeley, Cal.
(investment castings)

Industrial Fine Castings Ltd.
272 Geary Ave.
Toronto, Ontario, Canada
(investment castings)

International Nickel Co., Inc., The
67 Wall
New York, N. Y.
(investment castings, nickel alloys)

Intricast, Inc.
P.O. Box 60
Loudonville, O.
(investment castings)

Investment Casting Co.
60 Brown Ave.
Springfield, N. J.
(investment castings)

Investment Casting Co.
Saegertown Rd.
Meadville, Pa.
(investment castings)

Jelrus Precision Casting Co., Inc.
136 W. 52
New York, N. Y.
(investment castings)

Joseff
129 E. Providencia Ave.
Burbank, Cal.
(investment castings)

Kolcast Industries, Inc.
36101 Euclid Ave.
Willoughby, O.
(investment castings, stainless steels, nickel alloys, cobalt alloys)

W. O. Larson Foundry Co., The
799 Barchard
Grafton, O.
(investment castings)

Lawrence Laboratory
1668 Euclid
Santa Monica, Cal.
(investment castings)

Liebros Casting Co., Inc.
237 Kent Ave.
Brooklyn, N. Y.
(investment castings)

Lynn Casting Corp.
2609 N. San Fernando Blvd.
Burbank, Cal.
(investment castings)

M & M Precision Casting, Inc.
P. O. Box 295, Endicott Street
Norwood, Mass.
(investment castings)

John H. Martin
Box 665
Richmond, Texas
(investment castings)

Mercast Mfg. Corp.
2620 First
La Verne, Cal.
(investment castings)

Midwest Foundry Co.
(A Div. of L. A. Darling)
66 Clark
Coldwater, Mich.
(investment castings)

Midwest Precision Castings Co.
10703 Quincy Ave.
Cleveland, O.
(investment castings)

Midwest Specialty Co.
614 First St., S.W.
Cedar Rapids, Io.
(investment castings)

Misco Precision Casting Co.
116 W. Gibbs
Whitehall, Mich.
(investment castings)

National Precision Casting Corp.
322 E. Berkley
Clifton Heights, Pa.
(investment castings)

Northern Precision Casting Co., Inc.
Pell Lake, Wis.
(investment castings)

Omni-Metal Castings, Inc.
135 11th Street
Brooklyn, N. Y.
(investment castings)

Paramount Precision Casting Co.
910 W. Jackson Blvd.
Chicago, Ill.
(investment castings)

Perfect Casting
671-81 Flushing Ave.
Brooklyn, N. Y.
(investment castings)

Perficast, Inc.
800 8th Ave.
New York, N. Y.
(investment castings)

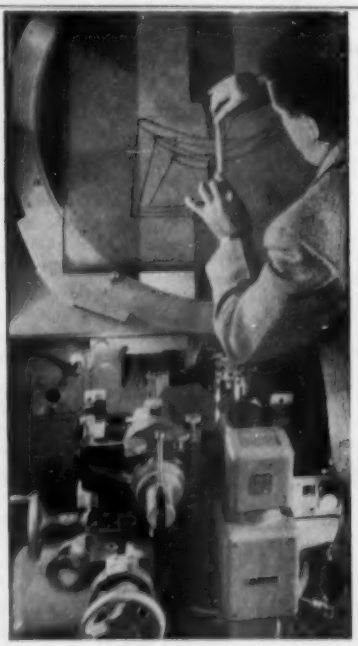
Picco, Inc.
335 S. Raymond Ave.
Pasadena, Cal.
(investment castings)

Precision Cast Parts Co.
5001 S.E. Johnson Creek Blvd.
Portland, Ore.
(investment castings)

Precision-Cast Products Co.
736 Arch
Philadelphia, Pa.
(investment castings)

Precision Metal Products, Inc.
P. O. Box 98
Gurley, Ala.
(investment castings)

for the airfoil shapes . . . now and in your future



MISCO engineer checks for *absolute* accuracy of an investment cast blade by use of a 30" Jones & Lamson Optical Comparator.

. . . look to Misco

Unusual configurations found in airfoils are not generated by accident — they are designed with purpose in mind. Reproduction to blueprint is accomplished by meticulous inspection at MISCO. The inspection equipment shown above is but one facet of our dimensional control procedures.

MISCO produces investment castings which power many of the most recently developed turboprop and turbojet engines. Currently we are the third largest producer of investment castings. The demand for MISCO engineering service and products has led to the establishment of manufacturing facilities at three points, totaling 160,000 square feet of engineering and manufacturing space, staffed by technically qualified personnel, working with the very latest equipment — much of which has been MISCO designed.

Quality is our byword. Our staff of Misco employees provides skills, technical know-how and creative engineering for your needs in *Airfoils.*

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Sales Offices in Principal Cities

Address inquiries to Sales Department 116 West Gibbs Street WHITEHALL, MICHIGAN WHitehall 2-1515

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Precision Metalsmiths, Inc.
1081 E. 200
Cleveland, O.
(investment castings)

Rausch Mfg. Co.
770 Cromwell Ave.
St. Paul, Minn.
(investment castings)

Rode, Inc.
5 Green
Woburn, Mass.
(investment castings)

Frank Roth Co., Inc.
4280 Park Ave.
Bronx, N. Y.
(investment castings)

Scientech Co.
Box 511, 812 Hill St.
Independence, Kansas
(investment castings, pattern materials and equipment)

Scott Casting & Mfg. Corp.
4th & Cannon Ave.
Lansdale, Pa.
(investment castings)

Shields & Co.
10 Delancy
Newark, N. J.
(investment castings, nickel alloys, copper alloys)

L. E. Simmons Refining Co.
440 N. Orleans
Chicago, Ill.
(investment castings, metals and alloys)

Standard Tool Co.
Hamilton Street
Leominster, Mass.
(investment castings, pattern materials and equipment)

Supreme Precision Castings Ltd.
6637 Jeanne Mance
Montreal, Quebec, Canada
(investment castings)

Tectron, Inc.
652 N. Robertson Blvd.
Los Angeles, Cal.
(investment castings)

K. W. Thompson Tool Co.
20 Denton Ave.
New Hyde Park, N. Y.
(investment castings)

United States Castings, Inc.
316 S. Spaulding Ave.
Chicago, Ill.
(investment castings)

Universal Castings Corp., Inc.
5821 W. 66
Chicago, Ill.
(investment castings)

Wade Mfg. Corp.
3011 Newport Blvd.
Newport Beach, Cal.
(investment castings)

Westinghouse Electric Corp.
Blairsville Metals Plant
P. O. Box 128
Blairsville, Pa.
(investment castings)

Wheeling Bronze Casting Co.
36th & McColloch Sts.
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The Shaw Process is being used successfully in the production and development of aircraft, gas turbine, engine, and airframe parts; general steel, alloy steel, and non-ferrous castings; dies and molds for the die casting, plastic, forging, shell molding, glass and rubber industries.

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Inquiries from reputable organizations interested in our licensing program are now being solicited.

SHAW PROCESS DEVELOPMENT CORP.
Division of British Industries Corp.
Port Washington, N. Y.

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Detroit, Mich.
(investment castings)

York Castings, Inc.
32 Latta Rd.
Rochester, N. Y.
(investment castings)

Z & H Mfg. Corp.
31 Welcher Ave.
Peekskill, N. Y.
(investment castings)

Zenith Precision Casting Co., Inc.
130 W. 46
New York, N. Y.
(investment castings, investment materials and binders)

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Trenton, N. J.
(melting and burnout equipment)

All-Metals Precision Casting Corp.
18 School
Yonkers, N. Y.
(investment castings, pattern materials and equipment)

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North Haven, Conn.
(crucibles)

Anderson Chemical Co., Inc.
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(investment binders)

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(pattern materials and equipment)

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Bareco Wax Co.
Div. of Petrolite Corp.
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(pattern materials and equipment)

F. W. Berk & Co., Inc.
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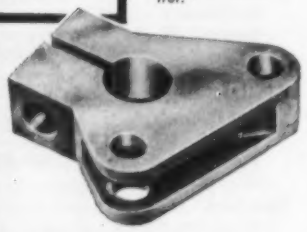
"EPCO Cast lever used by Mack Diesel trucks and buses on hydraulic governor control."



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Get an EPCO quotation before machining or assembling your intricate parts.

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(crucibles)

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New York, N. Y.
(pattern materials and equipment)

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Buffalo, N. Y.
(crucibles)

R. W. Greeff & Co., Inc.
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(investment binders)

A. P. Green Fire Brick Co.
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(investment materials)

Harbison-Walker Refractories Co.
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Kerr Mfg. Co.
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Bay City, Mich.
(melting and burnout equipment, furnace refractories)

Lava Crucible-Refractories Co.
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Lepel High Frequency Laboratories, Inc.
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(melting and burnout equipment, casting equipment, vacuum equipment, crucibles)

Manco Products, Inc.
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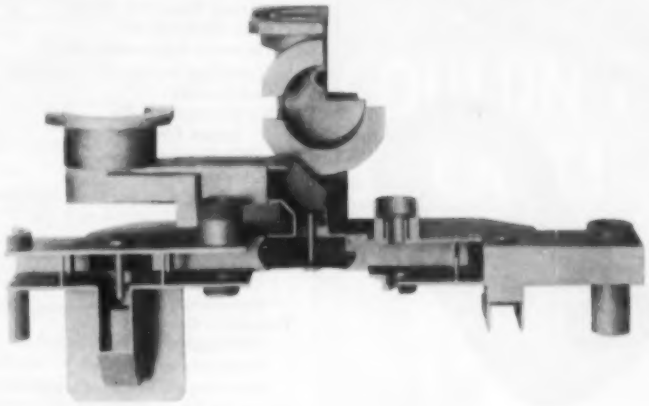
Melvindale, Mich.
(pattern materials and equipment)

National Aluminate Corp.
6216 W. 66 Place
Chicago, Ill.
(investment binders)

National Casting Products, Inc.
130 W. 46
New York, N. Y.
(investment materials and binders)

For more information circle No. 25 on the Reader Service Card

IMPOSSIBLE TO CAST?



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Investment Casting gives sound parts with smooth finish and close tolerances.

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Illustrated part weighing three ounces is cast of 2410 Stainless Steel. It is 2¼" long and 1⅛" wide. Check with us now to see if some of your small ferrous or non-ferrous parts can be made more economically by Investment Casting.

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W. Seneca St. • Manlius, N. Y.

Small precision castings of ferrous and non-ferrous alloys.

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Please send me literature on Precision Investment Castings.

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3 ALPHABETICAL

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Newton Highlands, Mass.
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Ohio Crankshaft Co.
Tocco Div.
3800 Harvard Ave.
Cleveland, O.
(melting and burnout equipment)

Optical Film Engineering Co.
2737 N. Sixth
Philadelphia, Pa.
(casting equipment, vacuum equipment)

Pangborn Corp.
10 Pangborn Blvd.
Hagerstown, Md.
(casting clean-up equipment)

Cerro de Pasco Corp.
300 Park Ave.
New York, N. Y.
(pattern materials and equipment)

Perma-Flex Mold Co., The
1919 E. Livingston Ave.
Columbus, O.
(pattern materials and equipment)

Pre-Vest, Inc.
23420 Lakeland Blvd.
Cleveland, O.
(investment materials)

Ransom & Randolph Co., The
P. O. Box 905
Toledo, O.
(pattern materials and equipment, investment materials and binders)

Reed-Prentice Corp.
677 Cambridge
Worcester, Mass.
(injection presses)

Riches-Nelson, Inc.
342 Madison Ave.
New York, N. Y.
(investment binders)

Ross-Tacony Crucible Co.
State Rd. & Milnon St.
Philadelphia, Pa.
(crucibles)

Alexander Saunders & Co.
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New York, N. Y.
(pattern materials and equipment, investment materials and binders, melting and burnout equipment, casting equipment, vacuum equipment, casting clean-up equipment)

Scientech Co.
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Independence, Kansas
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2375 Dorr
Toledo, O.
(melting and burnout equipment)

Tamms Industries, Inc.
228 N. LaSalle
Chicago, Ill.
(investment materials)

U. S. Stone Corp.
83 McLean Blvd.
Paterson, N. J.
(investment binders)

Van Dorn Iron Works Co., The
2685 E. 79
Cleveland, O.
(pattern materials and equipment)

Vesuvius Crucible Co.
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(crucibles)

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Louisville, Ky.
(investment castings, investment materials)

J. Yates Dental Mfg. Co.
340 W. Huron
Chicago, Ill.
(pattern materials and equipment)

Zenith Precision Casting Co., Inc.
130 W. 46
New York, N. Y.
(investment castings, investment materials and binders)

Zirconium Corp. of America
33697 Aurora Rd.
Solon, O.
(investment materials, pattern materials and equipment)

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Bedford, O.
(aluminum alloys)

American Smelting & Refining Co.
Federated Metals Div.
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New York, N. Y.
(aluminum alloys)

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PRODUCT INFORMATION AVAILABLE

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For more information circle No. 39 on the Reader Service Card

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aerocast

The accuracy with which DEAN Precision castings are made reduces the need for machining to a minimum. When machining is required DEAN facilities give assurance of one vendor economy. These facilities include: milling, drilling, tapping, reaming, grinding, hobbing, etc. SAVE time and money, one vendor economy and responsibility assures satisfactory results.

Check on DEAN services TODAY. Send us your prints or sketches for prompt engineering assistance and quotations.

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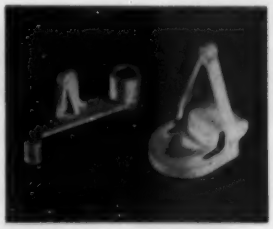

DEAN

aerocast

PRECISION CASTINGS INC.

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Phone: PLeasant 5501

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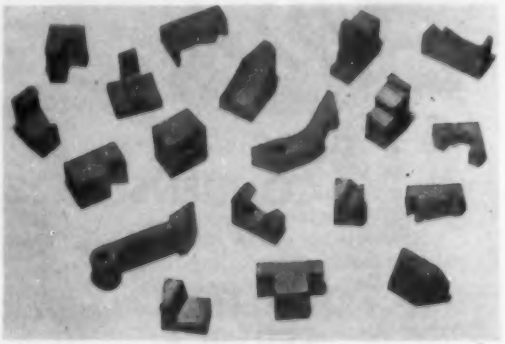

METHOD: Master block is made, a die is produced and the pieces are cast to exact size.

- **Eliminates Machine Tool Investment**
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Through investment casting you actually increase production, lower labor and overhead costs. We have complete facilities to do your next Investment Casting Job.

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Manufacturing Division
21250 W. 8 Mile Road — Detroit 19, Michigan

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Belleville, Ontario, Canada
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Charles Dreifus Co.
12 S. 12
Philadelphia, Pa.
(stainless steels)

Frankel Co., Inc.
19300 Filer Ave.
Detroit, Mich.
(investment castings, tool steels, stainless steels, nickel alloys, cobalt alloys)

General Electric Co.
1 River Rd.
Schenectady, N. Y.
(investment castings, low alloy steels, tool steels, stainless steels, nickel alloys, cobalt alloys)

Samuel Greenfield Co., Inc.
31 Stone
Buffalo, N. Y.
(aluminum alloys)

Haynes Stellite Co.
A Div. of Union Carbide & Carbon Corp.
725 S. Lindsay
Kokomo, Ind.
(investment castings, nickel alloys, cobalt alloys)

International Nickel Co., Inc., The
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(investment castings, nickel alloys)

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These rings were especially designed for hot chamber die casting machines. They will give LONG LIFE which reduces cost of maintenance. They are made of high grade wear resisting iron in sizes from 1½" to 4". We make prompt delivery in small quantities.

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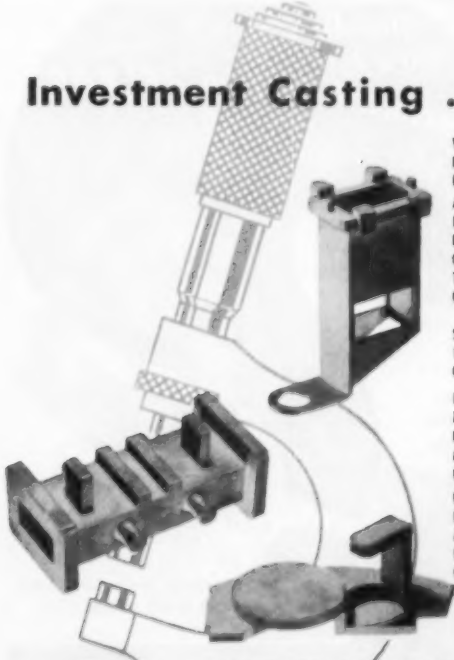

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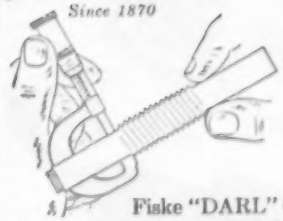

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DELCROME — investment castings
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DELORO STELLITE — metal and castings, Deloro Stellite

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PENNCAST — beryllium copper casting ingot, Penn Precision Products, Inc.

PERMA-FLEX — flexible mold and core box materials, Perma-Flex Mold Co., Inc.

R & R — investments
Ransom & Randolph Co., The

RAPID STONE — gypsum cement for model work, Kerr Mfg. Co.

REEDS — plastic injection molding machines, Reed-Prentice Corp.

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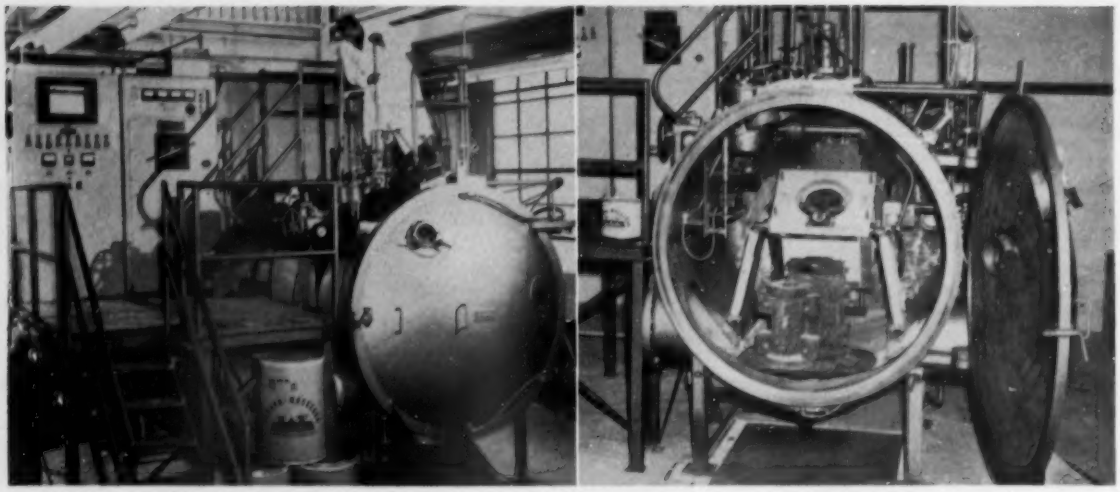

1. THIS VACUUM FURNACE consists of a tank, 6 ft. in diameter, 7 ft. long, which contains an induction furnace of 400 lbs. capacity. The system is powered by a 100 KW, 3000 cycle, motor generator set. The vacuum system is designed for pouring nickel, cobalt and iron base alloys at pressures less than 10 microns. The furnace was built by the F. J. Stokes Co. and was recently installed at Cannon-Muskegon.

This furnace has the accessory equipment necessary for refining and manipulation of the charge, including bridge-breaking equipment, additions mechanism, vacuum lock additions chamber, and provisions for taking temperature readings by immersion thermocouple.

There is a 3 ft. diameter mold table in front of the furnace which is rotated through a vacuum seal. Molds can be placed on this table and rotated under the furnace in sequence for pouring. This turntable is designed with a seal for rotation for centrifugal casting at speeds up to 800 revolutions per minute. The tank also contains provisions for preheating and cooling molds under vacuum.

Can you afford vacuum

Economics of

WHY should you be interested in vacuum melting? What has been done and what is being done on the investment casting of vacuum alloys? What equipment does vacuum melting require? How much will it cost you and what will the casting sell for?

Because vacuum melted high temperature alloys have definitely proven their superiority, the major consumers of high temperature investment castings are replacing present cast materials with vacuum melted wrought alloys. Based on preliminary tests and the fact that high temperature cast alloys generally outperform the wrought version of the same alloy, there is good reason to believe that investment cast vacuum alloys can give equal or better properties than vacuum wrought materials. At the present time, the investment casting industry is not prepared to take advantage of this opportunity or coming applications of vacuum melting in other fields.

The investment process is the only major casting method which can be used without basic revisions for producing vacuum castings of iron, nickel and cobalt base alloys. Several years ago, Cannon-Muskegon Corporation became convinced of the promising future of vacuum alloys in the investment casting field. We designed a vacuum furnace for development work in investment casting and for production of remelt alloys. This furnace is shown in Figure 1.

The production of high temperature alloys in this furnace parallels the procedure used by other vacuum melters with one important exception: Using air melting equipment, a base alloy suitable for the particular alloy to be vacuum melted is prepared with special deoxidizing procedures. This base alloy is charged into the vacuum furnace; after melting, the heat is deoxidized with carbon, and for high temperature alloys, boron, aluminum and titanium are added as required.

This procedure of producing air melted base alloy has some definite advantages:

1. The air melted base alloy can be made with a shape factor which best suits the power requirements of the vacuum furnace and has the most desirable packing factor.

2. In making up the base alloy, raw materials of the highest purity can be used with little regard for their gas content; for

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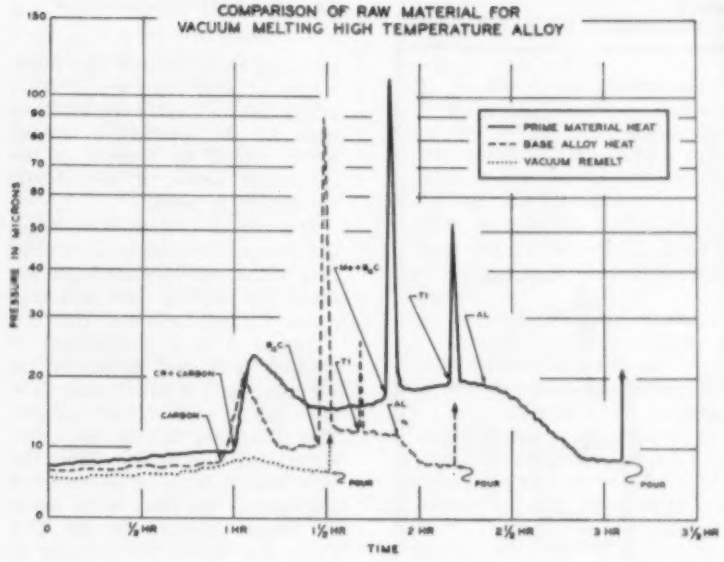
EDITOR'S NOTE: Such intense interest was shown in this paper when it was presented before the Investment Casting Institute meeting in May, that PMM reproduces it here for its readers. This is a vital topic today, especially for designers and producers of aircraft castings.



2. REDUCTION IN HEATING TIME by 25 percent due to the use of air melted alloys is indicated in this chart, which compares melting time and pressures for vacuum heats of prime materials, base alloys and vacuum remelt. Vacuum remelt time is less than half that for melting prime materials.

investment casting? Here are the facts . . .

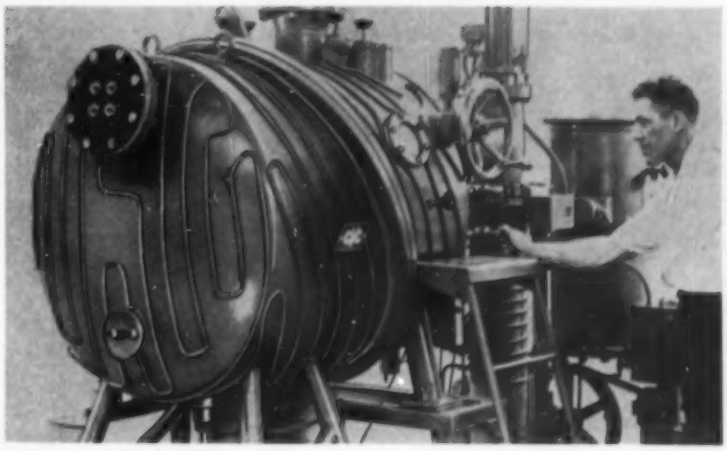
Investment Cast Vacuum Alloys

By F. Kenneth Iverson, Chief Metallurgist, Cannon-Muskegon Corp.

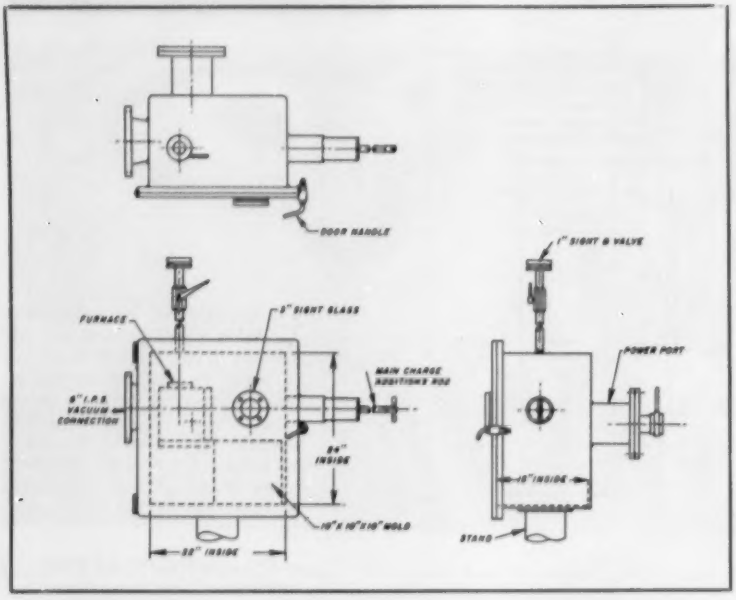
example, electrolytic chromium has excellent purity but has oxygen contents running as high as 0.5 percent. If charged directly into the vacuum furnace, it causes considerable difficulty. However, most of this oxygen can be removed in the preparation of the base alloy.

3. A material of exactly known gas content is charged into the vacuum furnace. The gas content of different lots of raw materials can vary considerably; however, in preparing base alloys, if good procedures are used, the gas content of the final material will be at approximately the same level each time, regardless of most variations in the gas content of the raw materials used. This provides the vacuum melter with the advantage of starting each heat with an exact known quantity of gas in the charge.

4. The total gas content of the charge is reduced appreciably



3. SIX TO NINE MOLDS PER HOUR can be poured using this vacuum furnace, specially designed by Consolidated Vacuum Corp. for investment casting. A 50-pound melt can be produced in 30 to 40 minutes; pressure in the chamber can be reduced to less than 10 microns in three or four minutes.



4. HERE'S HOW THIS VACUUM FURNACE WORKS. It has been specifically designed for investment casting, using vacuum remelted alloy. (a) The charging chamber and the furnace are loaded with separate slugs of vacuum melted material. A hot investment mold is placed inside the chamber and the door is closed. (b) The vacuum is turned on and the pressure in the chamber is rapidly reduced to less than 10 microns. (c) The furnace charge is melted in approximately three minutes. The melting cycle is controlled either by time and power or by optical temperature readings through a 1" sight glass. (d) As soon as the melt is poured, the cold billet slug of vacuum melted material in the charging chamber is placed in the furnace. (e) After waiting approximately one or two minutes for the investment mold to solidify and the furnace to be cooled by the cold slug to a non-oxidizing temperature, the door is opened, the mold removed, and the cycle is complete.

COST COMPARISON: AIR, ARGON & VACUUM INVESTMENT CASTING

CONDITIONS:

1. 1/2 LB CASTING.
2. 8 CASTINGS PER MOLD.
3. 50% YIELD NOT INCLUDING REJECTS.
4. 30% REJECTS FOR HIGH ALLOY CASTINGS AND 15% REJECTS FOR LOW ALLOY CASTINGS.
5. 30% MARGIN FOR HIGH ALLOY MATERIAL AND 20% MARGIN FOR LOW ALLOY MATERIALS.
6. VACUUM METAL COST - $3.00 PER LB OVER COMPARABLE AIR MELTED ALLOY.
7. FIGURES INCLUDE DEPRECIATION AND OVERHEAD.
8. VACUUM INVESTMENT FURNACE - INITIAL COST $60,000 - CAPABLE OF POURING 10 FLASKS PER HOUR.

ITEM	HIGH ALLOY MATERIAL			LOW ALLOY MATERIAL		
	AIR	ARGON	VACUUM REMELT	AIR	ARGON	VACUUM REMELT
MOLD COST	$35.00	$35.00	$35.00	$28.00	$28.00	$28.00
METAL COST PER MOLD	16.00	40.00	40.00	3.20	27.20	27.20
MELTING COST PER MOLD	2.80	5.20	9.70	2.80	5.20	9.70
CLEANING CUTOFF & INSPECTION	18.00	18.00	18.00	8.00	8.00	8.00
TOTAL COST	71.80	98.20	102.70	41.80	68.40	72.90
MINUS METAL RETURNS	6.34	6.34	6.34	.55	.55	.55
	65.36	91.86	96.46	41.25	67.85	72.35
MARGIN	19.61	27.59	28.04	8.25	13.57	14.47
	84.97	119.55	125.40	49.50	81.42	86.82
SELLING PRICE OF CASTING	$10.17	81.35	22.38	$ 7.28	11.97	12.77
INCREASE IN PRICE OVER AIR MELTING		60.3%	67.7%		64.4%	75.3%

5. HOW MUCH MORE WILL VACUUM CASTINGS COST? According to this tabulation of costs (including depreciation of a $60,000 investment over a 2-year period) vacuum investment castings will run less than double the cost of castings produced in air.

by using an air melted base alloy. Actually, with high temperature alloys, the base alloy contains less than 1/5 the amount of oxygen which would be present in the chromium alone, if electrolytic chromium is used.

The results of these advantages are obvious. The use of air melted base alloys for vacuum heats reduces the melting time and produces a more consistent product.

Figure 2 is a comparison of melting time and pressures for vacuum heats of prime materials, base alloys and vacuum remelt. This illustrates that the use of an air melted base alloy reduces the total heat time by 25 percent and also allows the heat to be made at lower pressure levels. This chart also shows the savings of time for a vacuum remelt. The length of time for a vacuum remelt heat is less than half the time required to produce from prime materials.

We have poured a number of different mold materials in our vacuum furnace, including investment molds, core sand molds, permanent molds, shell molds and others. At the present time, the investment mold appears to be the most satisfactory method f producing castings of iron, nickel and cobalt base alloys.

This does not mean it is without problems. The most serious problem that we have encountered is the outgassing of the mold during pouring. Even though this action can be quite violent, in most cases it does not appear to be due to any reaction between the metal and the investment material.

We have found several steps which help to reduce this difficulty:

1. Preheating the mold to a fairly high temperature (1800-1900 F.) under vacuum reduces the action. This is accomplished by putting the mold at 1800 F. into a preheating chamber, inside the vacuum chamber, before pumping down for a heat. While the charge is being melted, the mold temperature reduces to the temperature of the vacuum preheating chamber.

2. A second method which has had some advantage is to place

a pouring cup on the investment mold and raise the riser 2 or 3 inches. Even if the action is violent, sufficient amount of metal is retained in the riser to produce a sound casting.

3. There is some indication that substantial improvement is obtained by venting the investment mold so that the gas has an opportunity to escape by other routes than the casting cavity itself. Further work is needed on the exact type and location of these vents.

The work which has been done this far on vacuum investment castings has indicated that little change is necessary in gating or risering techniques. Gating methods which produce satisfactory results under static air pouring will produce good castings when poured in vacuum if proper mold materials are used. It is also true that poorly gated molds will not be improved by vacuum casting.

Not all dip coats are satisfactory for investment molds that are to be vacuum poured. Some dip coats, sodium silicate in particular, give a violent reaction when heated rapidly under vacuum.

Two basic processes can be used for the production of investment castings from vacuum alloys: 1. Remelting vacuum alloys under inert gas, generally argon; 2. Melting and pouring investment castings under vacuum.

Argon Remelting

Argon remelting consists of having the metal completely surrounded with argon at all times during melting and pouring. The metal never comes in contact with air. This is not as difficult to accomplish as you might suppose. The furnace must be fairly well enclosed but far from air tight. The argon is fed continuously and a slight pressure of argon is maintained in the chamber. When the metal has reached the pouring temperature, the mold is clamped on an opening and purged a few minutes before pouring. Specific considerations Pro and Con are listed above.

Vacuum Investment Casting

Investment castings can be produced under vacuum by starting with an air melted base alloy or prime raw materials; melting, bridge-breaking, deoxidizing,

Continued next page

SHOULD YOU CONSIDER ARGON REMELTING?

YES

1. As far as equipment costs, it is certainly the most economical method of producing castings from vacuum alloys. An existing furnace can be modified for argon melting for $400-$500. The complete equipment, including furnace and power supply, does not run more than several thousand dollars.
2. Without difficulty, production rates approaching those for air melting can be obtained.
3. With the high temperature alloys containing aluminum and titanium, argon remelting provides properties which compare favorably to vacuum melted properties. For these alloys, the stress rupture life of argon remelted material is in the range of 80 percent of the life of the vacuum alloy itself.

NO

1. There is a continuous loss of argon which results in a high melting cost. The exact cost is, of course, dependent upon the size of the chamber, its air tightness, and the rate of argon flow.
2. Present results indicate that there are many alloys where production argon remelting results in a substantial, if not complete, loss of vacuum melted properties. With some high temperature alloys which do not contain Al and Ti, argon remelting has shown insignificant improvement over the properties of good air melted materials.
3. It is difficult to control the quality of the argon melt. How does the operator know when the argon blanket is poor? He doesn't. In vacuum melting, there are gauges to determine the level of pressure and, providing they are accurate, the operator knows the condition of his melt. With argon remelting, the only evaluation of the condition of the melt is the performance of the casting. The only method of control which seems feasible would be to have a mass spectrometer reading gas conditions inside the furnace at a substantial increase in cost.

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making the necessary alloy additions, and then pouring the investment mold. For production use, this requires a high capital investment in an elaborate furnace having bridge-breaking equipment, mold heating facilities, additions mechanisms, and the other gadgetry associated with the complete melting and refining of a vacuum alloy.

Investment castings can also be produced economically and efficiently by remelting vacuum alloys. No additions are necessary. The alloy is merely remelted under vacuum conditions and poured into the investment mold.

Both vacuum systems have the obvious advantage over argon remelting, in that they can be used with all vacuum melted alloys and full advantage of vacuum melted properties is obtained. The vacuum remelting process has several additional advantages:

1. As shown in Figure 2, a vacuum heat made from prime materials requires twice the melting time required for vacuum remelting. This, of course, means that with the remelting process, the vacuum equipment operates at twice the efficiency and produces twice as many castings.
2. It is possible to design a furnace specifically for investment casting by vacuum remelting. Such a furnace would have a cost far below the price of the complete vacuum processing unit.

Figure 3 shows a 50-lb. vacuum melting furnace for investment casting. This furnace is designed for development and semi-production. The chamber pressure can be reduced to less than 10 microns in three to four minutes. Powered by a 30 KW generator, fifty pounds can be melted in 30 to 40 minutes. The furnace is fully equipped for basic vacuum processing. There is an additions mechanism, immersion thermocouple and sampling arrangements, and provisions for preheating and cooling molds. The vacuum chamber can accommodate two or three investment molds. In production, the furnace can produce six to nine molds per hour, depending on the raw materials used. This furnace sells for approximately $15,000, exclusive of power supply.

For the past year, we have been talking with vacuum equipment suppliers in an effort to obtain for the investment caster a furnace specifically suited for the vacuum remelting process. Figure 4 shows the basic features of a new furnace designed around these principles.

The following are features of this furnace:

1. This is a rapid pumping, high powered furnace using a vacuum melted alloy, capable of pouring 10″ x 10″ x 10″ molds at a rate of eight to ten molds per hour.
2. The 8-lb. furnace and the charging chamber accommodate slugs 2½″ in diameter by 6″ long; or 2″ in diameter by 8″ long. Billet slugs of this size are presently obtainable from vacuum melters.
3. The investment casters' present generating equipment may be applicable.
4. The cost except for power supply, is in the range of $5,000-$8,000.

How Much Will Castings Cost?

Certainly, the most important question is: What is the final casting to sell for, and what is the future?

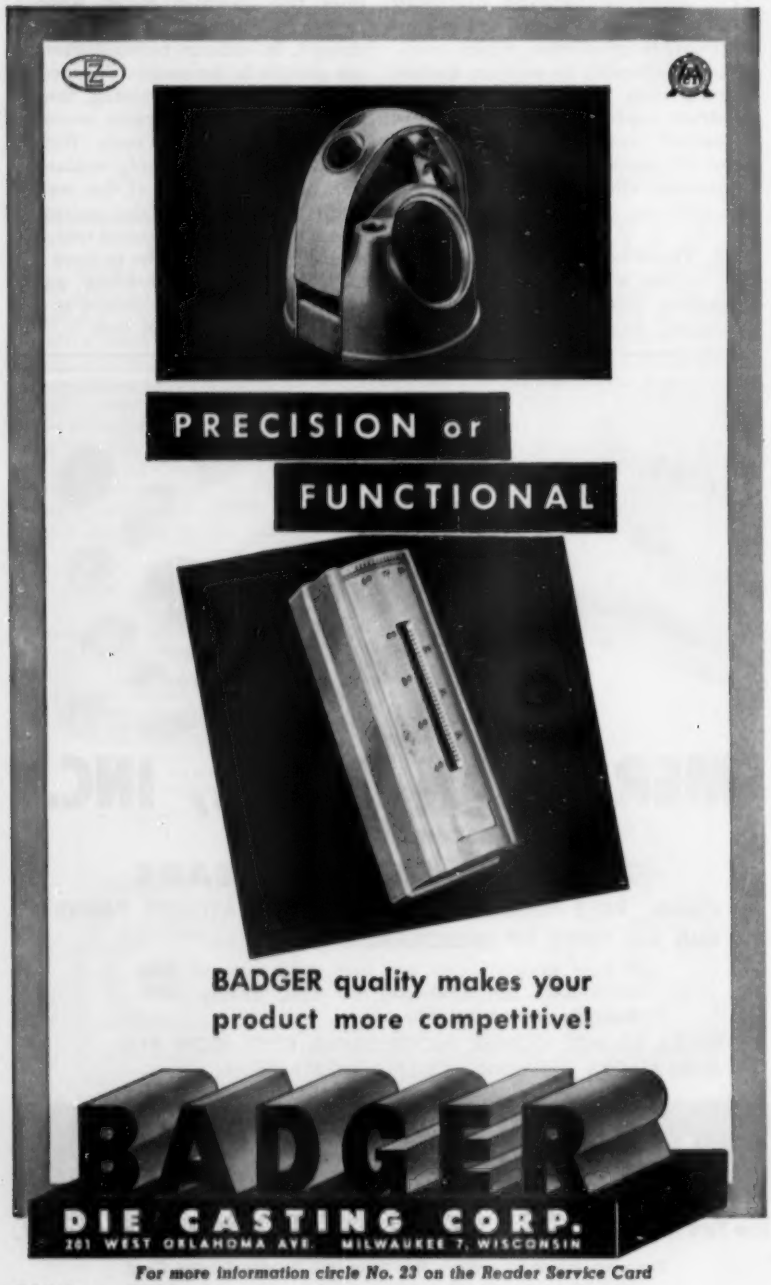

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Figure 5 is a cost comparison among air, argon and vacuum investment casting. In order to be conservative, we have based the vacuum portion on equipment currently available and not on the low cost remelt furnace previously discussed.

Costs vary greatly in the investment casting industry. The figures here are not necessarily representative of the industry as a whole. They do, however, represent the costs of some specific investment casters. Individual investment casters with different costs can use this basis to figure what their increase in price would be with the vacuum or argon melting process.

The vacuum melting cost may seem high, but, remember, it is a conservative estimate and includes the depreciation of the $60,000 investment over a two-year period on a one-shift basis.

The cost comparison is made on the basis of a constant rejection rate, regardless of the method of melting. If the majority of the investment casters' rejections are due to imperfections in the pattern or mold, they will not be reduced by vacuum melting. For those cases where a high percentage of the rejections are due to the metal itself, there may be a significant improvement. In some cases the savings due to reduce rejection rates may permit the vacuum casting to sell for the same price as the air casting.

The outstanding fact from this cost comparison is that vacuum investment castings will not necessarily sell for three or four times, or even twice the cost of the air melted castings.

There are real possibilities for the future:

1. The low cost vacuum remelting furnace will certainly reduce the melting cost.
2. The vacuum alloy processor will develop more efficient and economical methods of production with a corresponding decrease in basic alloy price.
3. Programs have already been initiated to determine the value of gates, risers and sprues from vacuum investment castings. There is every reason to believe that the price for vacuum metal returns will be substantially above the air metal returns price.

The day is rapidly coming when the vacuum investment casting will sell for less than one-third more than the air melted casting.

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THIS PLUNGER RING CAN SAVE YOU MONEY . . . TIME and Eliminate Lost Production

Precision UN-BREAKABLE TEMPERED and TREATED STAINLESS STEEL DIE CASTING PLUNGER RINGS

• The response to Precision's Stainless Steel Die Casting Rings has been tremendous. 75 new customers in 3 months. The reasons are obvious.

Precision Un-Breakable Plunger Rings are made of tempered and treated stainless steel. They are wrought, *not cast*, from dense, fine grain, flawless stainless steel. Engineered specifically for die casting machine applications, Precision Stainless Steel Plunger Rings give up to 8 to 10 times the average life of other rings. Produced under the most exacting methods, uniform tension and resiliency with long wearing, un-breakable and heat resistant qualities make it possible for plunger, groove and sleeve tolerances to be greater, thus eliminating unnecessary wear. Precision Rings are designed to allow for expansion under extreme heat and this feature with the characteristics of the stainless steel assures the finest, most dependable die casting plunger ring made.

Rings can be supplied in ¼" widths from 2¼" diameter up. They can be made to special diameters and widths.

Write for Precision's special bulletin on the stainless steel die casting plunger rings.

Precision's Engineering Department will gladly make recommendations on rings for your die casting plungers.

Precision PISTON RINGS, INC.

Sales Offices: INDIANAPOLIS—CHICAGO—LOS ANGELES—SAN FRANCISCO—NEW YORK—PHILADELPHIA

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STOP LEAKS

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For repairing cracks, holes, deep pitting — even pin holes in corrosion resistant fittings, pump parts, boilers, vessels, reactors, etc. Tamps in like putty—may be cut, sanded, polished. Has the inherent corrosion resistance of Titanium powder, if properly used.

Contains Unifide® Titanium Powder, 99+% pure

Available on a trial basis:

1 Jar — $ 7.50 Postage Prepaid
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GUARANTEED

If you manufacture, repair, maintain or work with or use corrosion resistant equipment, you NEED Titanium Mastic. Quantity prices quoted on request

UNITED INTERNATIONAL RESEARCH, INC.
38-15 30th Street, Long Island City, N. Y.

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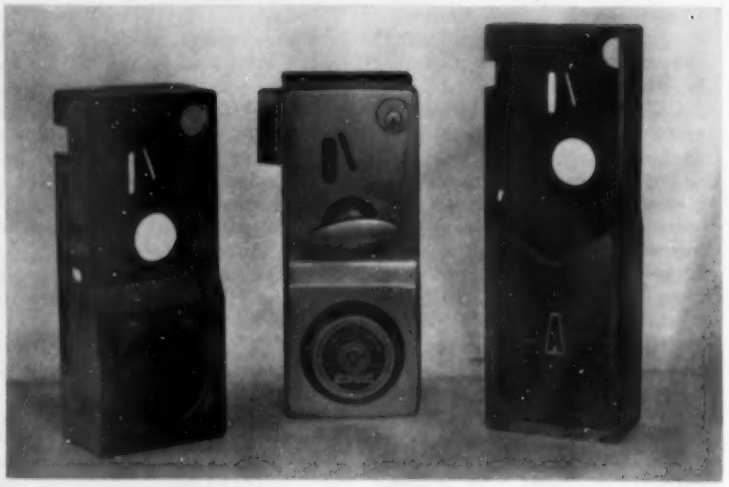
PLASTER MOLD CASTINGS



SILICON BRONZE is the alloy used for this smooth-surfaced housing for a coin-operated lock. The welded rear plate on the old type housing is indicated at "A"; plaster mold casting is at left.

Redesign Saves Six Machining And One Welding Operation

PLASTER mold castings have saved a number of machining operations for The Nik-O-Lok Company of Indianapolis, Ind. In production of the housing for one of their coin-operated locking devices, the company has made good use of a silicon bronze plaster mold casting, produced for them by Ohio Precision Castings, Inc.

Not only does this casting eliminate six machining operations that were previously required, but it also saves a welding operation and simplifies surface preparation prior to chromium plating. Most dimensions can now be cast within required tolerances.

Here are the operations which C. H. Wasson, plant superintendent at Nik-O-Lok reports have been eliminated by the plaster mold casting:

1. Beveling the coin slot,

2. Beveling the "Vacant" and "In Use" openings,

3. Drilling the pass cylinder hole in the upper face of the housing,

4. Machining a "dutchman" slot in the pass cylinder hole,

5. Machining the top catch on the inside of the housing to hold the mechanism assembly plate in position,

6. Cutting and fitting an insert for the back of the housing. (See "A" above).

7. Brazing or welding the rear plate in position.

The new casting method used to produce this housing has made it possible for the company to obtain high quality parts, capable of withstanding very severe duty, at minimum cost. The undercut interior portion can be used "as cast" because of the ability of plaster mold casting to solve difficult coring problems.

HEDGE TRIMMER

continued from page 56

Here the requirements clearly indicated a heavy shell with cast iron end bells. Such a construction was far to heavy and costly for the intended use and selling price. As an alternative, the possibility of deep drawn steel cups was considered. To secure the required rigidity required a stock thickness greater than could be drawn economically. Another problem with a deep drawn structure was to provide the necessary ventilation without requiring an expensive assembly operation to install the necessary screening.

The very natural result from these considerations was a zinc die cast case. With this method of fabrication, every desirable feature could be incorporated. The total weight of the case could be kept very low by casting thin wall shells but which still are sufficiently rigid. All necessary mounting and ventilating holes could be cored and in such a manner that screens over the ventilating ports are easily installed without a difficult assembly operation.

Further, practically every machining operation on the motor case was eliminated through the use of die castings.

Surface finishing also presented a problem. Since the trimmer is a consumer item, eye-appeal is essential. The entire trimmer is finished in a gray metalloid baked enamel. With die cast parts, this finish can be applied to the as-cast surface without any sanding, buffing or polishing. With any other method of fabrication, the surface would have to be at least ground and sanded before the enamel could be applied.

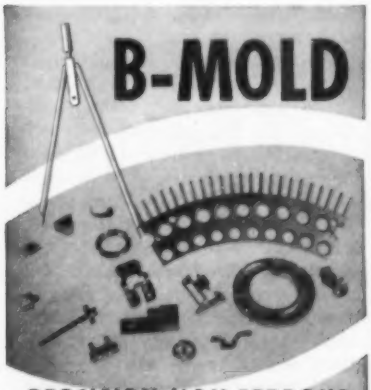
TITANIUM POWDER

continued from page 43

ported by H. W. Dodds, the process consists of filling a graphite mold machined to the desired contour with a weighed amount of powder, the mold and plunger then being installed in a vacuum sintering furnace as shown on page 43. After the furnace is sealed and evacuated to 1 or 2 microns the compact is heated to 850-900 C. Hydraulic pressure is applied through the top of the furnace and the powder is compacted to maximum density (sp gr = 4.52).

For volume production a press forming operation is used. In this process powder is charged into a tool-steel die and cold pressed at 50-100 tsi into a briquette. After static sintering in vacuum at about 1000 C the compact is cold-press formed to rough shape. A second press forming follows a second anneal and following a third anneal the part requires only a light machining operation to produce the finished part. The final density is 4.52.

Robins, Pitkin and Jenkins of G.E.C. Research Laboratories in England found that the use of titanium hydride in compacts resulted in greater densification on sintering than did titanium powder. Titanium hydride compacts sintered in vacuo at 1200-1300 C attained densities of 97-98 percent of theoretical. To achieve similar densification with coarse



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1000 Ton H.P.M.

Uniform, accurate, precision made castings to your exacting specifications!

(With special emphasis on thin wall distribution)

Plunger Diameter	Total Stroke	Effective Stroke	Capacity	Pressure on Metal (2100) Line Pressure	Projected Area Percent Fluidity vs. Sq. In. 100%	75%	50%
2"	24"	22"	6.9	31,500	65	95	130
2¼"	24"	22"	8.7	25,000	80	120	160
2½"	24"	22"	10.3	20,000	100	150	200
2¾"	24"	22"	13.0	16,500	120	180	240
3"	24"	22"	15.6	13,000	155	225	310

(with proportionate data changes up to 30 lbs. capacity)

1,000 Ton Clamping Pressure
Injection 9" Below Center

22" Stroke
24" Minimum Die Thickness
54" x 54" Platen Size

48" Daylight Between Platens
31" x 31" Between Strain Bars

Multiple Cavity Economy Effective in Small Castings

This machine is equipped with "nitrogen over oil" providing extremely high injection speed.

WRIGHT ENGINEERING & SUPPLY CO. 1300 SO. BANNOCK DENVER, COLORADO

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For more information circle No. 4 on the Reader Service Card

titanium powder required two cold-press-plus-sinter operations after the initial compact sinter treatment. Even then the maximum reported density was 96.4 percent of theoretical. Similar behavior has been reported for zirconium hydride by Hausner.

The Utica Drop Forge Corporation announced in 1953 a method of compacting carbides as well as titanium and zirconium powders whereby 99.9 percent of theoretical density is obtained in only one press and sinter operation. Moreover, the density of the part was uniform even for complicated parts having undercuts, screw-threads, etc.

Very little grinding, if any, was necessary to finish the part. Tolerances of 0.003 per inch for titanium powder compacts were reported. The pressure used was about 25 tsi and the sintering temperature was 2100-2200 F. The key to the success of this very promising development is in the compacting of the powder, which has not yet been revealed due to patent considerations. It would also be important to know the extent of pick-up of oxygen and nitrogen at such high sintering temperatures.

As can be seen, the principal drawback in titanium fabrication is its high reactivity which requires the use of protective atmospheres. A method which does not require the use of a vacuum has been proposed in a patent by D. W. Rostron who sinters the compacts in the presence of an alkaline earth metal more reactive than titanium. He reports that calcium is preferred, but that magnesium, lithium, strontium and barium may be used. The compacts may be sintered while submerged in molten calcium or in a calcium vapor atmosphere. Little reaction with calcium is reported.

In the light of the recent developments in titanium powder metallurgy and the possibility of further expansion, H. W. Dodds suggested the possibility of reexamining the long sheath working technique as well as the increased search for further inventions in titanium powder metallurgy techniques.

An evaluation of properties, uses and economics of titanium powder metallurgy parts will be given in the concluding paper of this series.

INTERNAL SPHERICAL SEAT is formed in this die casting for a self-aligning bushing, without the use of loose cores. Interlocking cores in cover and ejector halves provide portions of the curvature in each quadrant. At right is shown method of inserting bushing retainer into flanged bearing block.

Internal Undercut . . . Without Loose Cores

CASTING an undercut interior in a die casting without loose cores or angled core pulls is a neat trick. Yet it is being done to produce a one-piece housing for a self-aligning bushing . . . with a spherical seat for the bushing retainer.

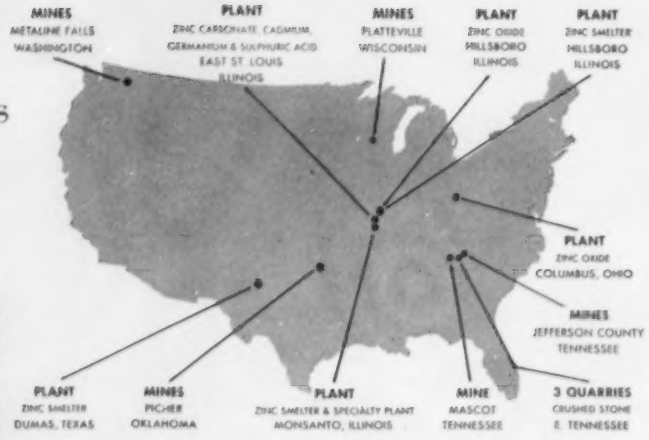
The flange-mounted pillow block consists of two zinc die castings and a porous bronze bushing. By some ingenious die design, the spherical seat is cored without loose pieces in the die at the Congress Drives Div. of the Tann Corp.

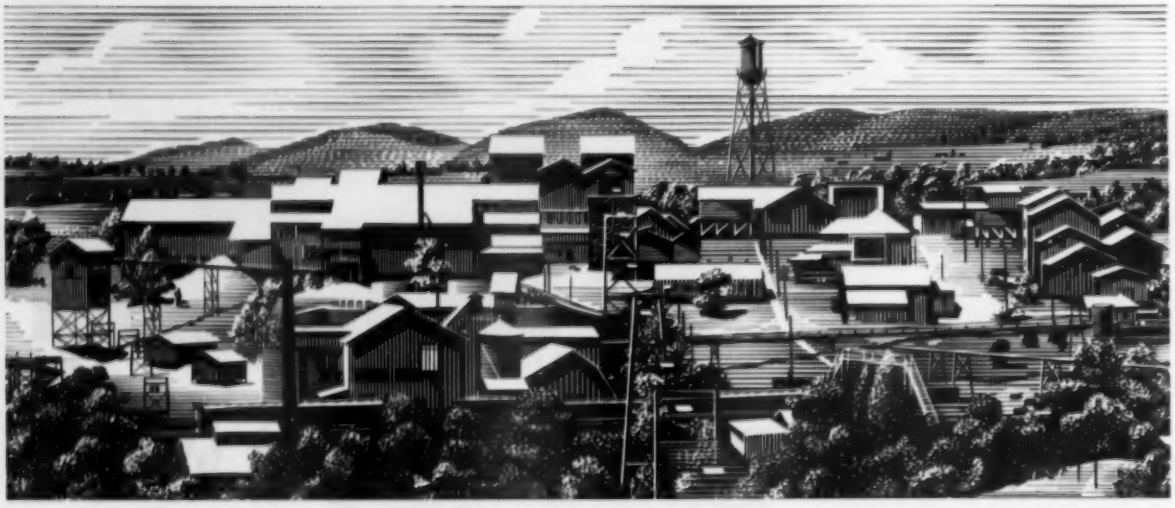
To secure self alignment through a wide solid angle a spherical member riding in a spherical seat is the natural solution. The use of a die cast bearing retainer with a spherical outside shape and a straight bore is a fairly obvious method of holding costs as low as possible, but the flanged member with the spherical internal seat, is an example of the high degree of flexibility of the die casting process.

In designing the flanged seat, one would be inclined to use two castings. The piece could be split along the major diameter of the sphere in a plane parallel to the flanged base, or it could be made as two castings that are mirror images of each other with the joint along a center line at right angles to the base. In either case, some provisions would have to be made to fasten the two parts together. The casting and trimming operations in this case would be increased due to having twice as many pieces to handle. A machining operation would be added, screws or bolts would have to be provided and an additional assembly operation performed.

For any service requirement to which this pillow block should be put, only one-half of the spherical seat is required. Since this gives adequate support it is then possible to design *casting dies with interlocking cores so that both a straight and spherical section are formed. The spherical section on each core member is one-fourth of the spherical surface, thus making it possible to pull the cores since there are no undercuts or re-entrant curves.* Further, by making the length of the bushing retainer slightly less than the chordal length, along the major diameter, of the curved quadrant, it becomes possible to assemble and disassemble the unit as shown above.

American Zinc and its products *from* A *to* Z





CONCENTRATING MILL, MASCOT, TENNESSEE

One of the key factors in American Zinc's widespread mining and milling operations. In Tennessee, American Zinc also owns and operates mines in Jefferson County. It is here that one of the largest known reserves of zinc in the United States is found (in excess of 1,250,000 tons of recoverable zinc, proven, with additional large reserves indicated). Other company-owned and operated mining properties are located at Platteville District, Southern Wisconsin; Metaline Falls District, Eastern Washington; and Picher field of the Tri-State Area (Missouri-Kansas-Oklahoma). For the complete picture, see map above.

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American Zinc sales Company

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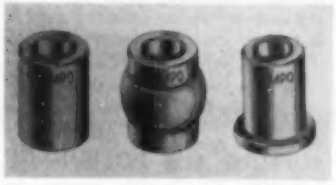
For more information circle No. 10 on the Reader Service Card

NEW PRODUCTS AND DEVELOPMENTS

Want complete details on these announcements? Use the Reader Service Cards. You'll find them facing page 16 of this issue

POWDERED METAL COMPOSITION FOR GENERAL BUSHING APPLICATIONS



A new powder metallurgy compound developed for the production of low cost, oil retaining bearings has been made available for general use.

The new product is said to bridge the gap between the sintered iron products and sintered bronze products that have been made for several years by the company. Composed of approximately equal parts of iron and bronze, it combines the economy and strength of iron with the antifriction and long-life properties of bronze.

While primarily intended as a low-cost, general-purpose bearing material, it can also be fabricated into sintered structural parts.

Boundbrook Oil-Less Bearing Co.
For more information, circle No. 196 on the Reader Service Card

THREADED INSERTS SPECIFICALLY FOR DIE CASTINGS

Threaded inserts designed specifically for die castings and other soft materials where strong threads are required have recently been announced. These inserts are designed to be molded directly into the part and require no secondary operations for inserting or locking.

The inserts are knurled to prevent rotation, and hold them in place; additional strength against pullout is obtained by two circular relief bands on each insert. Thread sizes currently available are from No. 2 to ⅜" in both NC and NF.

The inserts are made in two series: tapped straight through and blind. Class 2 threads are standard, but class 3 is available on order. All inserts are free of chips, and accurate hole sizes are maintained to facilitate mounting on pins of the molding presses.

The standard inserts are of brass, but inserts of steel, aluminum and stainless steel are available if desired.

Standard Insert Co.
For more information, circle No. 197 on the Reader Service Card

SMALL PARTS CONVEYORS MOVE DIE CASTINGS FROM CASTING MACHINE

An easily maneuvered conveyor, called The Partsbelt, has been introduced, designed specifically to handle small parts such as die castings, stampings, plastic moldings and screw machine pieces from the press or forming machine into the tote box, bin or continuous conveyor.

Available in lengths of 4, 6 and 8 feet and three widths, the conveyor operates at a speed of 76 feet per minute one way. It is driven by a 1/3 HP gear-head motor, single or three phase, with control switch and cord.

It is adjustable by one man, and can be set level 18" to 31" or at slopes to 60 degrees. Built entirely of steel, it has two 5 inch wheels for easy moving.

Standard Conveyor Co.
For more information, circle No. 198 on the Reader Service Card

UNIVERSAL ABRASIVE MACHINE DOES ALL BELT OPERATIONS

A new abrasive belt machine is said by the manufacturer to perform any of the basic abrasive belt applications found in a grinding, polishing or deburring department.

The extension arm assembly can be rotated a full 360° on the motor hub for the most convenient operating position for the various applications.

Other operations that can be performed only on this machine are

CUTTING OIL
. . . reduces machining costs

With the introduction of a new cutting oil a direct reduction in processing costs in a wide range of cutting, boring, and broaching operations is reported to be possible. The new material is a soluble oil, a heavy-duty emulsive coolant formulated with extreme pressure properties.

The product is easy to handle and prepare for production runs. It mixes readily with temperate water, either hard or soft, provides a highly stable emulsion and has excellent rust inhibiting properties.

The Texas Co.
For more information, circle No. 212 on the Reader Service Card

COPYING SHAPER
. . . is template controlled

A new hydraulic shaper that is template controlled for machining external contours has been introduced.

According to the distributor of the machines, such parts as splines, contoured punches, externally contoured sections, metal removing electrodes or punches, short-run contoured pieces and others are quickly and accurately made with set ups no more complex than those on a conventional shaper.

Haller, Inc.
For more information, circle No. 213 on the Reader Service Card

MILLING MACHINE
. . . has hydraulic depth control

A newly designed milling machine, called the contourmaster, has been introduced. In addition to the standard manual and power table feeds, this machine is equipped with a hydraulic depth control making it particularly suitable for die-sinking operations.

The machine is of the knee-and-column type of structure, the column being truncated to provide a turret-like swivel mount for the cross sliding ram which carries the spindle head. This swivel mount permits a shaping attachment, carried on the rear of the cross ram, to be instantly swung into position over the work-piece for shaping or slotting operations.

The Cincinnati Milling Machine Co.
For more information, circle No. 214 on the Reader Service Card

formed contact wheel grinding operations on a contoured piece; flat grinding application on a platen; direct contact wheel grinding operation with a work rest; grinding or polishing operations on a hard-to-get-at area with interference-free idler contact roll.

This multi-purpose unit is of rugged construction, with a totally enclosed motor, sealed ball bearings, automatic spring loaded belt tensioning and positive belt tracking. By speeding up many grinding, polishing and deburring jobs, the machine is said to cut production costs.

Curtis Machine Corp.
For more information, circle No. 199 on the Reader Service Card

BUFFING AND POLISHING LATHE
. . . features wider swing

A two spindle, variable speed buffing and polishing lathe with a wider than normal swing has recently been announced.

The new lathe has a swing of 20" from the side of the base to the face of the inner flange instead of the 12" swing of conventional lathes.

The two spindles operate independently, each having its own motor and variable speed control. This added flexibility permits work at a single lathe by two operators who can change wheels or vary speeds without interfering with each other. Down time on the machine is, thus, materially reduced. Each operator has a full 5, 7½ or 10 HP on each wheel. Spindle speeds can be changed while the lathe is running.

Hammond Machinery Builders, Inc.
For more information, circle No. 201 on the Reader Service Card

ABRASIVE-LOADED BUFF
. . . cuts finishing costs

A sectional, impregnated abrasive buff for both ferrous and non-ferrous metals is said to reduce finishing costs materially. Since the abrasive cake and compound used in non-impregnated buffs ranges from 12 to 24 times the cost of the buff itself, this new impregnated unit is reported to make a major attack on this cost item.

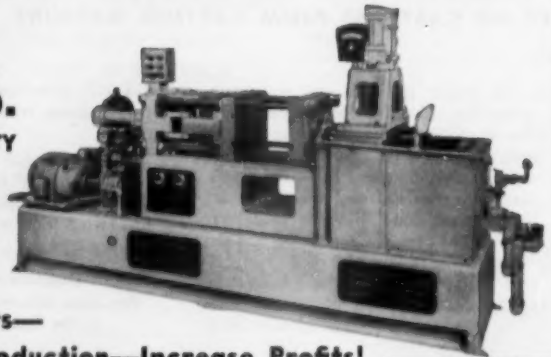
The new buffs are made of specially-tested bias cut cloth, impregnated with selected abrasive grains bonded throughout its entire construction. With this construction the new buffs are said to be competitive to sisal buffs, in the finer grit sizes, for normal cutting-down operations such as to prepare surfaces for color buffing, plating, etc. In the coarser grit sizes they are competitive to set-up wheels, coated abrasive belts, Tampico brushes and other polishing and buffing devices.

The Carborundum Co.
For more information, circle No. 202 on the Reader Service Card

HERE IT IS! A LOW COST—HIGH SPEED
DIE CASTING MACHINE

UP TO FULL
2½lb.
SHOT CAPACITY

Over 1100 Free Cycles Per Hour!



Reduce Costs—
Speed up Production—Increase Profits!

Now you can run high grade castings, up to 2½ lbs., at high speeds and low operating costs. Actual tests operating 8 hours a day, 5 days a week, show total cost of gas and electricity of ONLY 17c PER HOUR!

Outstanding features include—all steel welded construction—automatic electric cycling at high speed—17¾ x 17¾" die platens—6½" die stroke—highest grade controls and valves mounted for easy maintenance and accessibility—a complete package with self contained unit.

Available in Air or Hydraulically operated plunger gooseneck type for zinc, tin or lead, or, cold chamber type for aluminum, brass and magnesium.

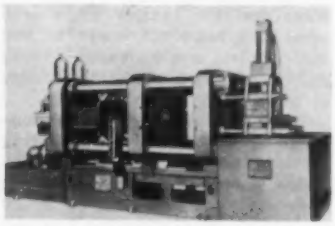
Write for Free Illustrated folder containing complete data on all models.

AMERICAN DIE CASTING MACHINERY CO.
1521 Thomas St., Chicago 22, Ill. PHONE: Armitage 6-3334

COMPONENTS
(Standard Equipment)
- VICKERS Hydraulic System
- GREER Accumulator
- NORTH AMERICAN Blower
- SQUARE-D Electrical Controls
- MARVEL Syncilnal Filters and other high grade and nationally known brands.

For more information circle No. 8 on the Reader Service Card

1000-TON DIE CASTING MACHINE FOR GENERAL USE



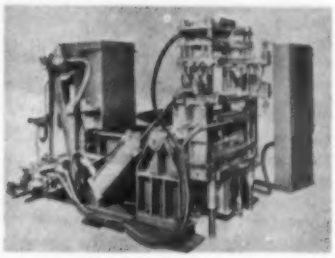
A new 1000-ton die casting machine, capable of injecting up to 49 pounds of zinc or more than 14 pounds of aluminum, has been introduced. The large Model BH-60 weighs more than 79,000 pounds, and has 10" thick solid die plates, each weighing over 10,000 pounds.

These die plates, measuring 72" x 54", provide die space of 40" x 32" clearance between tie bars. Die opening stroke is 24", adjustable for less stroke if desired.

New hydraulic system provides an extremely fast operating cycle, up to eight free cycles per minute with injection pressures up to 32,000 psi and injection speeds up to 1000 fpm.

Kux Machine Co.
For more information, circle No. 203 on the Reader Service Card

SHELL CORE & MOLD BLOWING UNIT UP TO 90 CYCLES PER HOUR



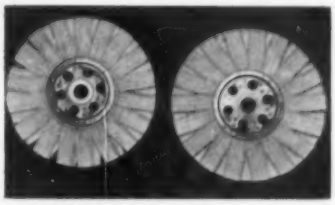
A completely automatic machine that blows and cures smooth, precision cores, both solid and hollow, along with shell molds, has been developed.

The new machine operates at 50 to 90 cycles per hour. The automatic cycle is said to assure uniform quality production, even with an unskilled operator. Coating and curing times are adjustable and pattern temperatures are thermostatically controlled. Core boxes and molds are the split type, independently gas heated.

The machine, complete with control panel, requires only about 7' x 7' floor space. Maximum box size is 14" x 10" x 24", maximum draw 5", maximum core or mold weight 16 pounds. A larger model is also available which handles 20" x 38" x 10" core boxes.

Sutter Products Co.
For more information, circle No. 200 on the Reader Service Card

LINE OF BUFFS CUT & COLOR SIMULTANEOUSLY



Fast, thorough cutting and coloring of intricately contoured surfaces is provided by a new line of cloth and sisal buffs.

The new buffs can be used in a wide range of heavy and medium metal finishing processes according to the manufacturer. They will cut and color metal in a single operation, due to their design and materials of construction.

Made in two types, the buffs utilize double-folded tufts to provide maximum cutting surfaces and retain compound at the leading edges and on the buff circumference. Tufts are staggered in a double row around the buff to prevent streaking. The construction is such that the buffs are self ventilating, insuring cool operation.

Hanson-Van Winkle-Munning Co.
For more information, circle No. 204 on the Reader Service Card

POLISHING, GRINDING WHEELS FOR PORTABLE HAND TOOLS

A new line of small "PG" wheels —designed for polishing metal with portable hand tools has been announced.

The wheels, which have the same basic design as the company's large polishing and grinding wheels are composed of die-cut pieces of coated abrasive cloth, bonded with resin and locked into a hub.

The new wheels are particularly suited for work in the appliance, stainless and sheet steel fabricating, metal polishing, plating and tool and die industries. They replace small set-up wheels.

The small wheels are especially suited for polishing soft metals such as lead and solder because the coated abrasive cannot become filled. The mineral grains and the backing wear away together, presenting an always new surface to the work. This action assures a constant polishing pattern, since mineral grains never become dull; and the rate of cut is constant through the life of the wheel.

Minnesota Mining & Mfg. Co.
For more information, circle No. 208 on the Reader Service Card

Continued next page

HEAVY DUTY TAPPING . . . with small drill presses

By using a planetary gear arrangement which reduces the tap speed to 1/3 of the spindle speed, a new tapping head is said to be able to do extra heavy tapping on small drill presses.

Because of the reduction gearing arrangement used, the torque needed for tapping up to and including ½" diameters in steel can be secured on small drill presses.

The unit is equipped with a visible grip tap chuck which can accommodate any standard tap or button die holder.

Ettco Tool Co., Inc.
For more information, circle No. 205 on the Reader Service Card

MINIATURE CONNECTOR . . . for thermocouples

A new, miniature screw type connection head for thermocouples, electric heating elements or swaged magnesium oxide insulate conductors has been announced.

Stem sizes adaptable to the new connector head are 1/16", 1/8", 3/16" and 1/4". These new sizes will provide a screw-type connection between the small gaged thermocouple wires and the larger gage lead wires. All sizes are made in two models, plain and with angle bracket. Operating temperatures range up to 500F.

Stress and vibration of the conductor is eliminated by transferring the load to stem or bracket. Connector fastens to the stem by a collet type fitting that can be easily assembled or disassembled at the point of installation. Wire connections are made under large headed screws.

The Marlin Mfg. Corp.
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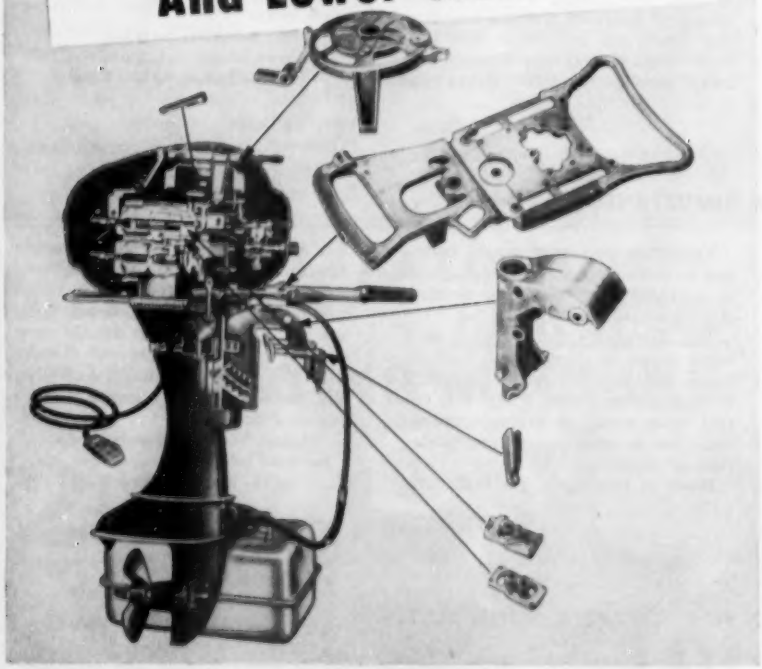

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COLLET CHUCK . . . for fast, accurate chucking

Designed for shank type tools, a new chuck is now offered that is said to allow faster grip and release and more accurate chucking of all shank type cutting tools.

These new chucks can apply a powerful, accurate centering fit to tools simply by twisting the threaded lock-and-eject nut. This draws a split collet with a tapered OD into compression against a mating taper on the ID of the chuck. The lock-and-eject action of the chuck greatly reduces the time needed to make a tool change.

Scully-Jones & Co.
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DUST COLLECTOR . . . utilizes water mist

Engineers concerned with dust removal from the air now have a new type of dust collector available according to the manufacturer. Instead of depending upon mechanical means of removing the dust from the air, the new collector mixes atomized water with the dust laden air. The dust is transferred to the water and separates out with it.

Dust laden air enters the collector and expands in the inlet chamber. The reduced velocity allows the larger particles to separate out and be collected as a wet sludge. The finer particles, still suspended in air, pass through venturies where atomized water is mixed with the high velocity air. On expanding in the final collecting chamber the dust laden water separates out and is removed. Special surfaces in the discharge chamber against which the dust, air, water mixture impinges aid in the separation. The cleaned and washed air is then discharged from the collector.

Pangborn Corp.
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OPPORTUNITIES

jobs & equipment

Opportunities rates: $20 for the first column-inch; $15 for each additional column-inch payable in advance. To answer box number advertisements, address responses to the box at Precision Metal Molding, 812 Huron Rd., Cleveland 15, Ohio.

PERMANENT MOLD DESIGNER—Qualified to design efficient, trouble-free molds. Must be a good mechanic, ingenious, have solid foundry background. Must have qualifications to take his place as part of nucleus of rapidly growing, progressive organization. Location New Jersey. Salary open. Please send complete resume. Write Box No. 6156.

FOR SALE—40 KW Lindberg Fisher electric aluminum 2 stage furnace and electric control panel. Brand new — 2 years old. Price $3500. Chicago White Metal Casting, Inc., 5239 W. Grand, Chicago, Illinois.

SALES REPRESENTATIVE—aluminum, bronze, magnesium castings—Should be well versed in foundry practices in sand, permanent mold and die casting operations. Develop new territory with good potential. A fine opportunity for a well trained ambitious person. All replies treated in strict confidence. Oberdorfer Foundries, Inc., Syracuse, N. Y.

ONLY THE BEST — We need competent metallurgist who likes people — therefore enjoys success in technical sales; who knows ferrous melting; who likes to guide his own destiny — therefore aspires to management; who is resourceful, imaginative, creative—therefore above average. Knowledge of tool, stainless, superalloys desirable. Home base will be Detroit area. Tell us about yourself and we'll do the same. WaiMet, 1999 Guoin, Detroit 7.

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LEPEL HIGH FREQUENCY CONVERTER FOR SALE: 30 KW excellent condition; Heat treating furnace 8 x 12 x 20 complete with automatic controls good condition. New Optical pyrometer 1400 to 3400 degrees. Write Box No. 6256.

OFFER SCHOLARSHIPS

Joseph A. Martino, president, National Lead Company and Dr. Asa S. Knowles, president of the University of Toledo, have announced in a joint statement that National Lead Company has established a scholarship program in engineering at the University of Toledo. This is part of an educational plan to help meet a critical shortage of trained manpower in the fields of chemical, electrical and mechanical engineering, and engineering physics.

The scholarships are open to high school graduates in the vicinity of Toledo, Ohio; Grand Rapids, Michigan; Pottstown, Pa.; and Batavia, N. Y.

The initial four scholarships in engineering will be awarded in May of this year, following competitive examinations.

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GARDEN TRACTOR

continued from page 51

on the drive member. There has never been a failure of this part even when this reinforcing is not used and future assembly will eliminate it. Note that the groove in this drive member is machined in by the fabricator after the part is pressed and sintered.

The simultaneous brazing and sintering have thus eliminated two manufacturing steps, drilling the holes and brazing the pins in place, with consequent reduction in the part costs.

In Figure 1, the other sprocket shown is also in the power transmission train. This part, however, is rigidly fixed to a shaft by a key and set screw. Here, wear is the most important factor and to achieve the properties required simply required the selection of the proper powder technique by the fabricator.

The two parts shown in Figure 2 represent the old and the present methods of making a cog belt drive pulley. As originally designed, this pulley was made from a group of seven stamped parts that were riveted together to make the assembly. On this part wear was excessive and tool maintenance to make the parts was high.

Normally, because of the under-cut surface, this part would be rejected for manufacture from metal powders. With proper die design, in this case a four segment die, the Powdercraft Corp. who make all of the parts described was able to **fabricate a pulley from iron powder that has consistently out-performed the former piece and has made the part at a considerably lower per piece cost** than the older method of manufacture.

This pulley is on the main engine drive and must transmit the full torque developed by the gasoline engine used to power the tool. It should be noted that shapes such as this one can rarely be made from metal powders. Tooling costs are very high and production rates rather low so that production from metal powders can only be done in exceptional cases.

Figure 3 shows two different sized support brackets and one of the locking bars used with them. Four of these brackets, two of each bore size, are used per unit. These brackets serve as both support members and bushings. They are made somewhat porous to achieve oil retention, but must be hardened to give adequate strength.

In addition to serving the functions noted above these brackets are designed to permit adjustment for chain tension. Once the desired chain adjustment is secured the bracket must be locked securely and permanently in place. This is accomplished by forming teeth in the base of the bracket and then making a locking plate with mating teeth that securely holds the bracket in place when pulled into place with a nut on a fixed position bolt.

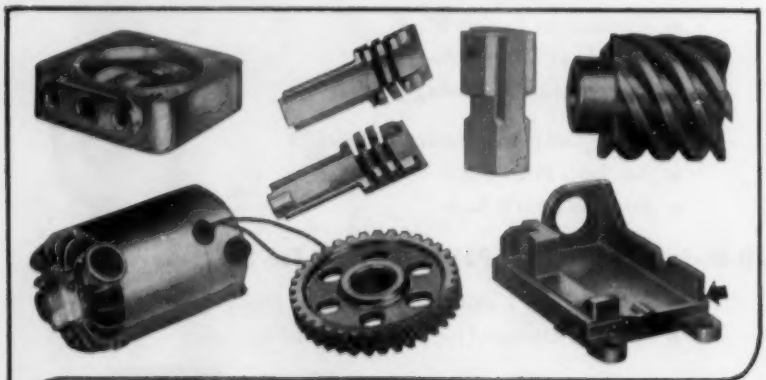
Forming Locking Teeth

Experience with other methods of manufacture showed that these locking teeth could not be formed accurately enough by any method other than slow and expensive milling before the part was pressed from metal powders. Since milling was economically impossible, this design, though mechanically sound, was impractical until a shift was made to powder metallurgy.

Strength and shock resistance are very important in these brackets. Two of them must carry the entire weight of the power unit and which ever attachment is in use. Not only must this weight be carried, but the part must resist the impact that results during use. These parts are, therefore, carburized throughout and subsequently hardened.

There are a number of other parts on the Roto-Hoe that are made from metal powders. These are, however, principally self lubricating bushings. In every case where such bushings have been used the design is such that standard sized parts can be used. This has the advantage of lower first cost, elimination of tooling costs and also easy replacement if it should ever be necessary.

While the number of parts made from metal powders is now quite impressive, more will ultimately be used. At the present time, another sprocket in the transmission is scheduled for production from metal powder. Other parts are constantly being studied and reviewed with the idea of shifting to powder metallurgy as a production method wherever production economics will justify such a change.



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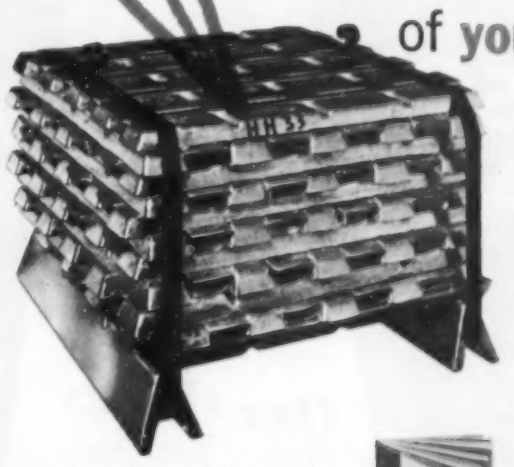

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Lock manufacturer finds key to 33⅓% cost reduction in

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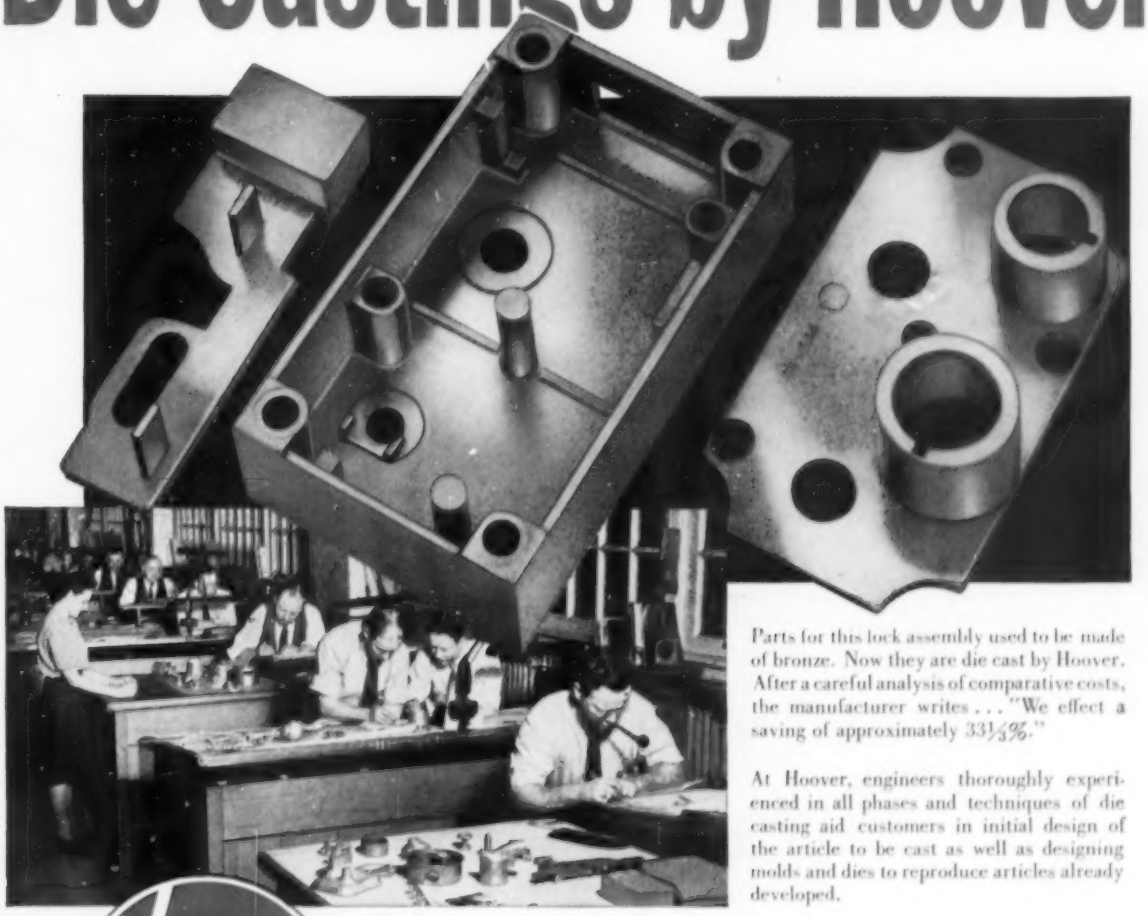

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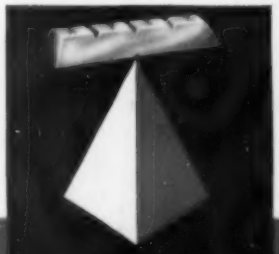

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